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A Method For Measuring Trend in Range Condition on National Forest Ranges With Supplemental Instructions For Measurement and Observation of Vigor Composition and Browse

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Administrative Studies
(Condition and Trend)

June 15, 1954

A METHOD FOR MEASURING TREND

IN

RANGE CONDITION ON NATIONAL FOREST RANGES

with supplemental
Instructions for

MEASUREMENT AND OBSERVATION OF VIGOR COMPOSITION AND BROWSE

U. S. DEPARTMENT OF AGRICULTURE

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FOREWORD

The range condition and trend study initiated in 1948 and completed in 1951 was westernwide in scope and involved many people -- in both the administrative and research branches of the Forest Service. The list of those who took part in the field tests in the design of the method for the determination of trend in condition of forest ranges, or otherwise contributed to the specifications herein, includes principally:

Northern Region
- John A. Fallman
- John S. Forsman
- Fred W. Johnson
- Thomas Lommasson
- Daniel G. Massing
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California Region
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Pacific Northwest Region
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- Oliver Cliff
- George A. Garrison
- Robert W. Harris
- Clark E. Holscher
- Floyd Iverson
- Fred H. Kennedy
- Joseph F. Pechanec
- Elbert H. Reid
- Charles R. Waldron

In August 1951 the method was considered at two meetings. The first was a field meeting held at the Manitou Experimental Range, Colorado, and attended by administrative and research personnel of the Forest Service. The method was accepted and approved by this group for use in the western regions. The second meeting, held at Denver, Colorado, was attended by representatives of the livestock industry, State Colleges, and other State and Federal agencies interested in range use by livestock and game. This group was much interested and voiced general approval.

RR(G)
SUPERVISION
Administrative Studies
(Condition and Trend)

A METHOD FOR MEASURING TREND

IN

RANGE CONDITION ON NATIONAL FOREST RANGES

By

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Range Conservationist (Research)

Approved, October 17, 1951

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U. S. DEPARTMENT OF AGRICULTURE

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A METHOD FOR MEASURING TREND

IN

RANGE CONDITION ON NATIONAL FOREST RANGES

INTRODUCTION

The range condition and trend study has been conducted within the western national forests and was carried out by the Division of Range Research of the Washington Office with the cooperation of the Division of Range Management and the six western regions and experiment stations. The study was brought about by a realization that one of our greatest needs in range-management planning is a simple, practical method for the determination of trend in range condition. Facts on the condition and trend of our ranges are needed, in order that decisions regarding management and adjustments in connection therewith may be wisely made. Such facts are necessary for a better understanding of our aims in the administration of forest-range watersheds not only by the general public but by range users as well. It is believed that cooperation between administrators and stockmen in management of the range will be greatly facilitated once the facts on trend have been determined. This is particularly true on ranges where the trend may be questionable. Information also is vitally needed which will eventually lead to the development of sound condition standards. As yet no method of sampling range units for condition and trend is in general use.

In appraising range condition and trend, we are dealing not alone with the influence of livestock but with a complex set of factors relating to the vegetation, soil, and native animals both large and small and even micro-fauna, especially in the soil, which are constantly changing from one growing season to the next. Both range administrators and stockmen are interested in whether these changes are in the direction of improvement or in a downward trend of deterioration. They want to know how much of the change is due to current weather and how much to grazing use.

In the administration of national-forest range we are attempting to manage such vast areas that the question of what we should like to do in the way of record taking on condition and trend is largely colored by what we can do with the limited funds and personnel available. Hence, it seemed logical to combine precise methods of measurement with extensive wide-scale estimates (as in range condition mapping) wherein the precise method serves as a benchmark for repeated measurements and as a definitely marked point to which we can constantly return to check personal judgment of the general condition within a large, extensive type or key area.

The primary objective of the study has been to develop a method or methods which are simple, practical, accurate, technically sound, and which will yield concrete measurements as well as sound observational

evidence of trend. It must be largely a method which the average ranger can readily apply or at least a method wherein the ranger can play an important part. Accordingly it must not be too time-consuming and it must be one by which two different individuals can obtain the same answer. Also it must be a method which the administrators as well as the stockmen can readily understand and one in which they will have mutual confidence. It must also meet with the approval of range ecologists.

The condition and trend study was begun in July 1948. The first year's field work was devoted to getting acquainted with the range types and conditions in the six western regions--and to a consideration of methods in use by Administration and Research for appraising condition and trend. Significant findings were:

1. All regions and stations agreed that in order to follow trend in condition information must be taken periodically on density, floristic composition, vigor, litter, soil capabilities, and erosional features.

2. That the initial step toward development of a method for following trend should be in perennial grasslands and open timber-grassland types in various stages of condition, because they are the most important for range and usually comprise the key areas on an allotment.

3. All agreed that to follow trend most efficiently, we must have permanently located range plots or transects established within the allotment, trend being determined by repeated measurement of these plots at periodic intervals of time.

For the 1949 field work a specific method designated the "3-Step Method" was proposed for trial in each of the six western regions. The method tested incorporated many ideas from other measurement methods. It was presented to the field as a preliminary step in the further evolution of a method and to stimulate thinking.

The 1949 tests conducted in the six western regions with the 3-Step Method were very encouraging. It has been found to be rapid and accurate. The differences between men in making the measurements are extremely low. The method is sensitive in reflecting differences between and within condition classes. Results of the 1949 tests and the revised method were presented in a mimeographed report issued in June 1950 and distributed within the Forest Service, to key individuals in the livestock industry, to other range administering agencies, and the state experiment stations.

The 3-Step Method of measuring and observing various elements of the site was tested during 1949 and 1950 in a wide variety of range types in various stages of condition, representing a large segment of national-forest range in the West. Attention, however, was focused primarily on the perennial grasslands, including mountain meadows and sagebrush-grass,

and open-timber types because of their importance in forage production and their significance as key areas. The main job accomplished in 1950 has been further refinement and to test actual application of its establishment on an allotment basis.

As a means of securing an understanding of its potentialities by stockmen as well as Forest Service administrative personnel, the method was explained and demonstrated to a group of Montana stockmen. Their reaction was very favorable and several suggested that a method such as this should also be applied to private range. Many administrative personnel on the ranger and grazing staffmen level took an active part in the testing and refinement of the method. It was the general consensus of the men--both Administrative and Research personnel--who had taken part in the tests, that the method offered promise of being a practical measurement tool for the determination of trend in all of those types and condition classes.

It is the purpose of this report to set up the general specifications of the 3-Step Method, together with the basis for these specifications and how the method can be used to determine condition and trend on national forest ranges. While this method has been designed primarily for use on national forests it is believed that it will be useful on other ranges, both public and private.

THE 3-STEP METHOD - WHAT IT IS

The 3-Step Method incorporates the best features of several measurement methods - reduced to as simple a record as practicable for the purpose of measuring trend. As the name implies it consists of three major steps. Step One is concerned mainly with the establishment on the range of permanently marked transects and the collection of the basic field data from these transects and from the site within which they are located. Step Two consists of the field analysis of these data, classification of condition at time of record and estimation of current range trend. Step Three is concerned with a permanent photographic record of range conditions on the site that is sampled. Except for establishment of transects, since they are permanent, all three steps are repeated and the results compared step by step in any subsequent examination in later years.

The establishment of transects permanently located within the key areas of the range anticipates that the initial and subsequent data collected therefrom will eventually form a historical document as to changes in vegetation and soil erosion rates that may occur through the years on these specifically designated sites. It is essential that the transects be permanently located within these sites for it is only in that way can we go back to the same line and check exactly what has happened. If a new and temporary set of transects were selected each time for observation it would introduce additional errors of sampling which

might over-shadow some of the real changes that may have occurred. To overcome this would necessitate a greater number of additional transects than it is practical to observe. In other words the use of permanently located transects, with careful maintenance of the base record, is the most sound, efficient, and practical method for following trend.

The intensity with which the 3-Step Method is applied in sampling a large range unit will vary. Ordinarily, administrative needs will have to be satisfied with the bare essentials; and a minimum number of permanent transects, the data from which often may not be subject to ready statistical analyses. Accordingly it is this level of application that will be stressed herein. In a few situations, such as controversial or problem allotments, a high level of sampling accuracy will be desired and, accordingly, a larger number of transects will be required than usual. Whenever such situations do occur, the advice and guidance of Range Research on sampling techniques for securing complete randomization of transects, and statistical methods for analyzing the data obtained should always be secured prior to initiating the work.

STEP ONE

In brief, Step One consists of the initial establishment of permanently located line transects, and the recording and summarization of data obtained therefrom and within the area immediately adjacent to each transect.

Initial Establishment of the Transects.

The initial establishment of the transects within a range unit requires decision as to the selection of sites for placement of transects, how many transects to place within a cluster or group within the site selected for sampling, how many clusters to place in each condition area, how the transects should be arranged within an individual cluster and how the transects are actually established on the ground. These points are covered as follows:

Selection of Sites for Transects.

Ordinarily sites for placement of transects will be selected within the allotment on the basis of being "representative" of each major condition situation existing in the grassland, meadow and open timber types. If shrub or woodland types are important, representative sites within these should also be considered for selection. The larger openings within the timber, shrub or woodland are preferred locations because these normally form the grazing areas favored by livestock. Chiefly, the transects will be placed in primary range areas. These are the areas which produce or are potentially capable of producing the bulk of the forage values. They should not be placed in sites that are unusable for range such as dense timber or rocky inaccessible slopes. On the other hand the sites selected for transects must not be located in areas where livestock normally concentrate

excessively, as on salt grounds, fence corners or immediately adjacent to permanent stockwater. They should be a minimum of 100 feet from any fence, including exclosures. In rolling (slopes less than 20 percent) to level terrain grazed by cattle, they should not ordinarily be less than one-fifth mile or more than one mile from permanent water, except where such location is necessary to obtain a sample of range in satisfactory condition. This may be an area that is lightly or seldom grazed by livestock, and records from such areas are necessary for determining the effects of weather on condition of vegetation. On similar topography, but grazed by sheep, transects may be as close as one-eighth mile and as far out as two miles from permanent water. In meadow types it may not be possible to place transects more than one-fifth mile from water. Selection of sites for sampling should be carried out cooperatively by the District ranger and stockman permittees.

Number of transects to place as a cluster in each site. Methodology for the calculation of the optimum number of transects per cluster representing each site has been previously reported.1/ On the Flagtail allotment in Oregon it was determined that two transects per cluster in the ponderosa pine and sagebrush-bitterbrush types and one transect per cluster in the meadow type were adequate. In the mixed grama grassland of the Southwest where vegetation is naturally more sparse, three transects appear to be the optimum. It is suggested that a minimum of three transect lines be placed in a cluster where the index of plant density is below 30; from 31 to 60, two transects; and above this, or 61+, one transect per cluster. This is largely in accord with the findings from the Flagtail allotment.

There are several sound reasons for placing transects in a cluster or group at each sampling site. It affords a larger sample of the vegetation and helps prevent the overlooking of rare species which may have important indicator values. It provides a measure of the variation within a sampling site and helps smooth out the differences in measurement between men. From a practical viewpoint, placement of transects in clusters is desirable because of the greater amount of useful information obtained per man-hour.

For ease in relocation, it is advisable to mark the location of transect clusters with a witness stake or post. A 5-foot steel fence post driven two feet or more into the ground is recommended. Since this is apt to attract livestock, it should be a minimum of 50 feet from the nearest transect.

Number of transect clusters necessary for sampling each condition situation. A minimum of two transect clusters per major condition class situation or area is suggested. For very small allotments it is acceptable to sample only one condition class (with two clusters) in which case neither the worst nor the best condition situation should be selected.

1/ Report on 3-step method for measuring condition and trend of forest ranges, by Kenneth W. Parker, 1950. In files, U. S. Dept. Agr., Forest Service, Washington, D. C. 68 pp., illus. (Proc.).

How transects are arranged within a cluster. Each transect is visualized as sampling a plot. In the case of a 100-foot transect this would be directly in the center, lengthwise of and equidistant from each end of a 150x100 foot plot. The purpose of this larger plot is to provide a definitely delineated area for observing indicators of current trend, soil movement, and to assure a record of rare but important indicator species which may not otherwise be encountered on the transect.

Transects may be arranged in any pattern desired within a cluster. For example, this may be end to end or side by side. Whether they are placed end to end or side by side they should be a minimum of 100 feet apart. Transects may radiate from a central hub with this point marked by the witness post but the plots must not overlap. Wherever possible, transects should always be placed parallel to the contour because this permits sampling drainages by cross section, the transects are less subject to complete destruction as by skid logging, and on steep slopes they are easier to measure.

Actual establishment of the transect on the ground. A metal tape 100 feet long with chaining pin notches (i.e., Keufel and Esser No. 7679) is stretched as tightly, as straightly and as closely as possible to the soil surface in the site selected for sampling. With the tape in place, three permanent angle iron stakes are driven along the same side of the tape, with the flanges parallel to the tape, at the 0.0, 50.5, and 99.5-foot marks. Placement of the stakes at these points avoids interference in making the loop readings, which begin at the 1.0 and end at the 100.0-foot marks.

Two or more different length of stakes - i.e., 12, 18, and 24 inches, with one end pointed, should be available for use, depending on soil depth. The stakes should be driven into the soil, so that only about 5 inches remain above the soil surface in order to prevent attraction of grazing animals to the site.

In some situations, such as narrow stringer meadows or rough terrain or dense shrub types, shorter length transect lines 50 or even 25 feet long are preferred to the 100-foot length, because of greater ease in establishment and greater facility in relocation and remeasurement. In any event, 100 observations are made with readings taken at 6-inch or 3-inch intervals, whichever is appropriate starting at the first 6-inch or 3-inch from 0.

Time of year for undertaking field work. The field work should, if possible, be arranged during the time of the growth season when the bulk of the plant species are most easily identified. Times to avoid, if possible, are very early spring at the beginning of growth or late fall especially following heavy grazing use. A record should be made as to current weather conditions, as well as for the previous year to answer such questions as: Is the record being made during severe drought, or in an unusually good year? Is current plant development early, late, or about average?

Recording Data from the Transect Line and Adjacent Plot Area.

Once the transect line has been staked out on the ground the basic field data record is obtained. The manner of recording the data will vary slightly between grassland and shrub types. For grassland and open timber types it is as follows:

Along the edge of the tape adjacent to the face of each stake, 100 observations are made at 1-foot intervals as marked on the tape from 1-foot to 100-feet by means of a 3/4-inch diameter ring attached to a long wire shank. (figure 1) The shank is about 16 inches long and in some models is equipped with a movable steel handle or with a self-centering bubble attachment for convenience in holding and for plumbing from the tape when the latter is above the ground surface.

As the ring or loop is dropped to the ground surface observation is made of whatever is encountered within the area delineated by the ring, and classified as to vegetation, litter, rock, erosion pavement, or bare soil. Each observation is recorded on the specially devised form shown in figure 2. (Use of alternate form shown in Figure 2A will reduce the time required for each transect, especially in compilation, but is not generally recommended unless time of personnel is strictly limited, as may occur whenever a large number of transect clusters have been installed on the range unit.) Perennial grasses and weeds must have the root crown or a portion thereof within the ring in order to be recorded as an observation. Crown spread of these is ignored in order to eliminate differences which would otherwise arise from utilization or current plant development. In rare cases two, or even three, plants of different species may occur within the same loop in which event all species are recorded by the proper plant symbol. It will be noted that each numbered space on the form is divided into two parts. This is to aid in a methodical entry of data and to facilitate later summarization. Thus the upper half of the square is used to segregate the desirable and intermediate species from the undesirable species which are entered in the lower half of the square. Species are classified in these groups largely in accordance with forage qualities, soil holding characteristics, and reaction to grazing use.

In general the desirable species are those which are characteristic of climax or at least sub-climax or pristine conditions, are good forage plants with deep fibrous roots (except for some herbs) which facilitate infiltration of precipitation and resist soil movement. The desirable species are best for sustained livestock production and should and would be most desired in abundance on the range by stockmen. This group also would include most of the introduced species that are used in range reseeding. The desirable species are maintained under proper grazing use. On deteriorated range they would increase under proper grazing use. On the other hand under excessive utilization the desirable species decrease, which has led to the adoption of the term "decreasers" by some plant

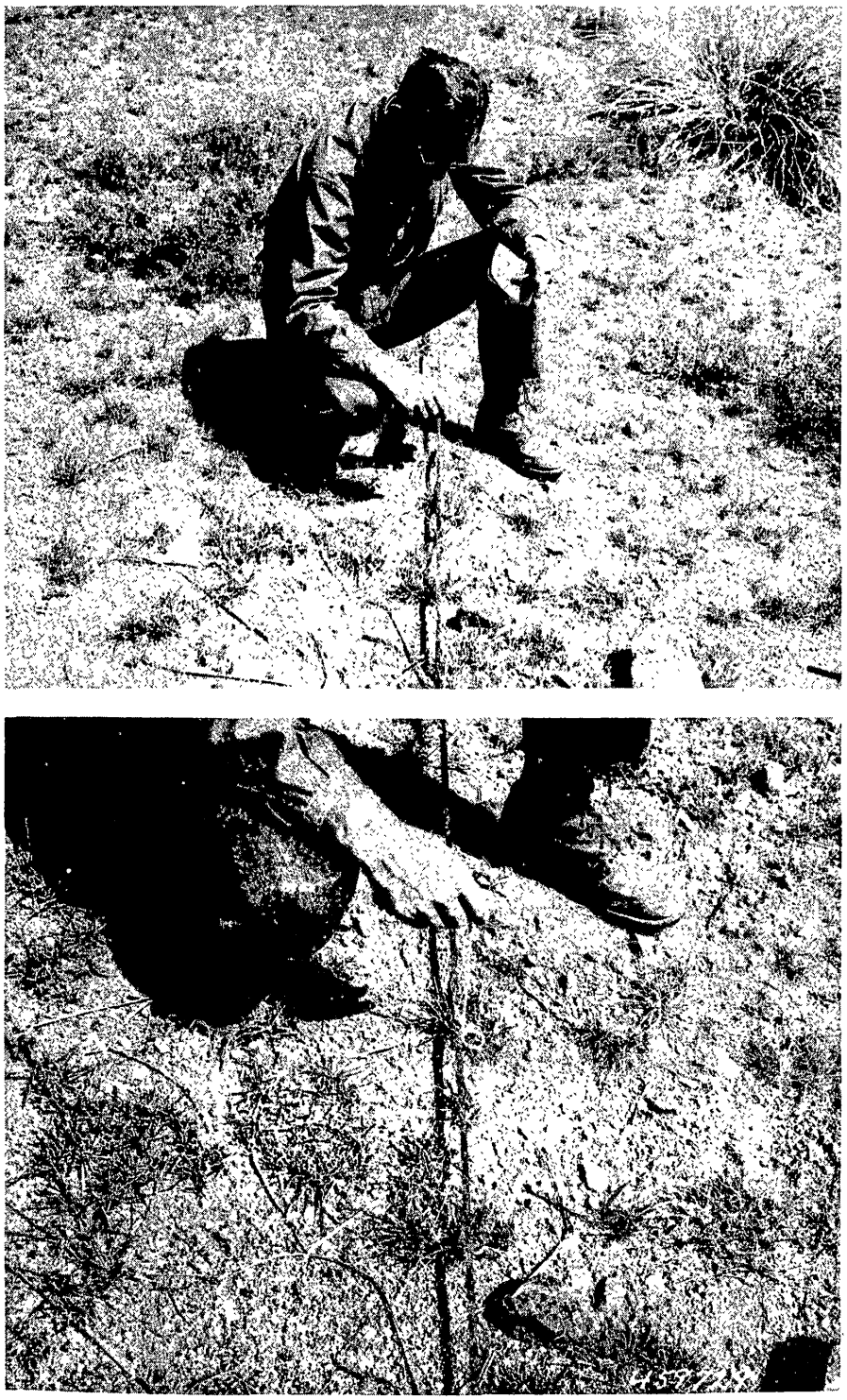

Figure 1. - Illustrating Step One (Of the 3-Step Method) - Upper photo - one man makes the readings and records the data as to species, litter, moss, bare ground, erosion pavement and rock. Lower photo - closeup of wire loop or ring (3/4 inch diameter) showing an observation on perennial grass.

RECORD OF PERMANENT LINE TRANSECT

Allotment Flagstaff Date 9/7/50 By John Smith Cluster No. 3

1	2	3	4	5	6	7	8	9	10
		STI			STI	Fsc	Fid	STI	
R	ARE		L	L	ARE				ARE
11	12	13	14	15	16	17	18	19	20
Pse		Fsc		Cx	AGR	Fsc	Cx	Cx	AGR
	M		ARE ANT						
21	22	23	24	25	26	27	28	29	30
			Fsc		Fsc				
L	—	ARE		ANT		L	L	M	R
31	32	33	34	35	36	37	38	39	40
Asm	Fsc	Dun	Cx	Cx	Ahi			Fsc	Ahi
						L	L		
41	42	43	44	45	46	47	48	49	50
Dun	Fsc	AGR	Fid	Cx	J			Fid	Fsc
					L	—	L		
51	52	53	54	55	56	57	58	59	60
AGR	Fsc Dun	Cx	Fid	✓	Fsc	Cx Fid			
				L			L	M	L
61	62	63	64	65	66	67	68	69	70
Fsc	Fid	Fid	Dun	Cx		Cx	Fsc	Fid	Fid
					L				
71	72	73	74	75	76	77	78	79	80
Fsc	Fsc		Cx	Fsc			Dun	Cx	Fid
		L			P	L			
81	82	83	84	85	86	87	88	89	90
	Dun	Dun	Cx			Fid		Dun Cx	Fsc
L				L	L		ARE		
91	92	93	94	95	96	97	98	99	100
Dun	Dun		Pse	Cx	Fsc			Dun	AGR
		L				L	L		

Transect No. 1

BARE SOIL	2.0
EROSION PAVEMENT	1.0
ROCK	2.0
LITTER	21.0
MOSS	3.0
PLANT DENSITY INDEX	71.0
TOTAL	100
FORAGE DENSITY INDEX	64.5
GROUND COVER INDEX	98.0
OVERSTORY	
UNDERSTORY	

SPECIES
(List by name, symbol and number of hits)

✓Festuca scabrella	Fsc	17.0
" idahoensis	Fid	10.5
Stipa spp.	STI	2.5
Agropyron Smithi	Asm.	1.0
Spp	AGR	5.0
Carex spp	CX	14.0
Danthonia Unispicata	Dun	10.0
Unknown Weed	0	1.0
Agrostis hiemalus	Ahi	2.0
Poa Secunda	Pse	2.0
Arenaria spp.	ARE	5.0
Antennaria spp.	ANT	1.5

KEY INDICATOR SPECIES NOT RECORDED

VIGOR MEASUREMENTS

	Fsc	Fid
1	13.5	7.5
2	13.5	8.5
3	12.5	5.5
4	21.0	8.0
5	12.0	7.0
6	12.5	6.5
7	16.5	7.0
8	14.5	6.0
9	14.5	8.5
10	11.5	7.5
Total	141.5	72.0
Avg. Max.	14.2"	7.2"

NOTE: List overstory species at top of each block and circle symbol when dead. L= Litter; R= Rock; P= Pavement; M= Moss; Dash = Soil.

DOT CHECK:

Annuals None

Figure 2. Form for recording information obtained in Step One.

RR - NW
Form 6

Record of Permanent Line Transect

Allotment _____ Cluster No. _____

Date measured _____ Observer _____

Species	Transect No. ___		Transect No. ___		Transect No. ___	
	Hits	Total	Hits	Total	Hits	Total
Plant Density Index						
Bare Soil						
Erosion Pavement						
Rock						
Litter						
Moss						
	Total	100.0	Total	100.0	Total	100.0

Forage Density Index .... _____ _____ _____

Ground Cover Index ..... _____ _____ _____

Overstory ..... _____ _____ _____

Understory ..... _____ _____ _____

Annuals ..... _____ _____ _____

_____ .... _____ _____ _____

Record vigor measurements on back of form for each transect.

Figure 2a. Alternate form for recording information obtained in Step One. Principal advantages over form shown in figure 2 is that summary is complete when work on transect is finished and all transects in a cluster can be recorded on a single form. Principal disadvantage - individual items cannot be re-checked and there may be tendency on part of examiners to do less careful work.

ecologists and by the Soil Conservation Service to designate this group of forage plants in range condition classification.

The undesirable group generally includes plants which are noxious or low value as forage, which are shallow or tap rooted or otherwise poorly adapted to holding the soil in place. Such species are generally low in the scale of plant succession. Many are undesirable foreign plant introductions. In general the undesirable plants are prolific seed bearers which enables them to rapidly invade bare soil. Under excessive grazing use on ranges in satisfactory condition they invade and replace the desirable and intermediate species. On the other hand, on ranges in very poor condition an increase in abundance is often the first sign of improvement. The term "invaders" is used to describe this group of plants in the range condition classification of the Soil Conservation Service.

The intermediate group of forage plants includes species between these two extremes and also species whose place in succession is not definitely known. Individual species in this group may decrease or increase or remain largely static under grazing. In general they are the first to increase and replace the desirable species whenever range in good condition is deteriorating. They are also the plants which are most apt to increase on ranges in poor condition which are improving. The intermediate group of species coincides largely with species designated as "increasers" by the Soil Conservation Service.

The lower half of each square is also used to enter the remaining observed items such as litter and rock. Seedlings of perennials not as yet definitely established are also entered on the form and the species indicated by a √ or + or other means of identification related to the species list. Annuals are recorded as a simple dot tally at the bottom of the form.

In the event there is no perennial vegetation other than club moss (Selaginella spp.) within the loop, a decision must be made as to what dominates or characterizes the loop. For example, if over half the loop is covered with litter, it is recorded as such. The same is true of club moss. If it is less than half occupied by either litter or moss it is recorded as bare soil, rock (rocks exceeding 3/4 inch diameter) or erosional pavement, (pebbles 1/8 to 3/4 inch diameter) whichever the case may be if they occupy 1/2 the loop area. Thus, these observations are roughly subjective, whereas vegetation excluding club moss is plainly objective requiring only a decision as to whether some of the crown is within the loop or not.

There are several sound reasons why the 3/4-inch diameter ring was adopted for measuring the various elements of the site. First of all, this size ring or loop is a compromise between a point and a plot. In other words it is a point of dimension of such size that different men can well agree as to what is inside it. Summarization of the data is as simple as classifying 100 different colored marbles as to color. If the ring were any larger in size the error between men either as to plant count or estimate of density cover would become prohibitive for

effectively recording data to show trend. This was borne out by tests of accuracy between men wherein plot frames of 2, 4, 6 and 144 square inches (12 x 12 inches) were utilized. Furthermore, as the size of plot is increased there arises the greater difficulty of summarizing the data. On the other extreme if the 3/4-inch diameter ring were any smaller such as a needle point or as large as 3/8-inch diameter, error due to replacement of the transect line in follow-up measurements increases and the sensitivity of the method in depicting differences between measurements decreases. To overcome these weaknesses would require additional readings, making the method tedious. The 3/4-inch diameter ring was found to be the most suitable size for recording mountain grassland, meadow or sagebrush-grass vegetation.

In the aspen type which is characterized by lush, several-storied weed vegetation, crown spread of all species including grasses and aspen sprouts but not club moss, is recorded in the upper half of the square and basal portions of the plant in the lower half, together with the other site elements. The record would thus comprise both crown and basal readings of vegetation. This procedure is recommended since study has not been continued long enough to tell what is the most satisfactory means of recording weed vegetation. Until this is determined a complete record would thus be available if necessary for later re-analysis, particularly with respect to floristic composition. Until then the basal readings would be utilized in the summarization as in the case of grassland vegetation. Work in the aspen type, particularly on sheep range should be accomplished prior to entry of livestock.

For shrub types the procedure in recording data is as follows: The surface vegetation and other observed items which occur between the shrubs are classified as described above - except that all such items are entered on the lower half of each square. The upper half of the square is reserved for entry of browse species. In observing these, only the perennial portion of the crown is considered, current annual twig growth being ignored, and dead portions of the shrub indicated by encircling the plant symbol. The characteristics of the area directly beneath the shrubs are observed as with surface ground cover. Shrubs are recorded up to 5 feet in height and constitute the item of "overstory". Surface vegetation directly beneath the shrubs is summarized as "understory". Recording the data on the form by this means not only facilitates summarization but permits comparison of similar records in subsequent years. By this means the observer may readily ascertain what is happening to the shrub population and changes that may occur beneath and between the shrubs. This is likewise true in the open grassland types where species are segregated on the form on the basis of desirability.

Measurement of vigor is made within the plot circumscribing the transect by determining the average maximum leaf length of each of the most important desirable species usually not over three. Plants which are measured are selected at random by pacing along the transect and within the plot. At the end of each pace the longest leaf found on one plant of each desired species is measured from the base to the tip of the leaf

and the measurement recorded. Ordinarily the average of 10 plants per species will suffice for each transect. Whenever individual measurements vary considerably a greater number of plants, i.e., 15 or 20 in lieu of 10, should be averaged. Care should be taken not to deliberately select the plants being measured. This can be done by looking away from the ground surface while pacing and taking the individual of each species closest to the toe at each stop. Plants which have been completely and closely grazed to the ground should not be recorded.

Measurements by species are recorded and the average maximum leaf length computed in the lower righthand corner of the form. Leaf length is used in preference to flowerstalks because it can be observed when the work is done early in the season. In the measurement of vigor by this means other criteria should not be overlooked. For example, the average maximum height of the seed stalks, number of seed stalks per plant, bunchgrasses with dead centers (except on very large plants only) or otherwise broken up into segments and remnants are observed whenever these criteria are evaluated in Step Two.

Summarizing the Transect and Other Data.

For grassland and open timber types, the 100 observations are classified and summarized in the upper righthand group of items. The number of hits ~~on bare soil, erosion~~ pavement, rock, litter, and club moss are counted individually and their totals recorded. Plant density index is the total of all squares with established perennial vegetation. The total of plant density and these other items should add to 100.

Forage density index is the total of all squares with either desirable or intermediate species (undesirable species are excluded from this count). Ground cover index is computed as 100 minus the total hits on bare soil.

The total number of hits for each species is also recorded individually with species names and symbols segregated as to desirability in order to facilitate later classification when all transects in the cluster are summarized. In cases where two or more plants are recorded in the same square a unit value of 1 is divided equally among them, i.e., if two plants occur each should be given a weight of .5.

In shrub types, the crown canopy is counted along with the plants growing between the shrubs for the item of plant density index. If the shrubs ~~are desirable or intermediate~~ species they will likewise be entered in the forage density index. Where two or more shrub species are recorded as occurring in the same loop, a unit value of one is divided equally between the species. All shrub species are grouped together in the item listed as "overstory" with the upper half of the square assigned a unit value of one. All herbaceous plants directly beneath the shrubs are grouped together as "understory" - and the lower half of the square assigned a unit value of one. These understory plants, together with other elements of the site directly under the shrubs are not considered in any other computation. This segregation of the shrubs into the separate item of overstory and the plants directly beneath into the understory vegetation facilitates comparison in subsequent follow-up records to ascertain not only what is happening to the shrub cover but also as to changes in vegetation directly beneath the shrubs.

STEP TWO

Step Two consists in the summarization and analysis of transect and plot observations for an entire cluster, the classification of current condition and the estimation of current trend. This is all done directly in the field on the site where the information obtained in Step One was collected.

Summarization and Analysis of Transect and Other Data.

As indicated on the transect cluster summary form, figure 3, all essential items are entered in it from each individual transect form.

Species on each transect within the cluster are segregated into three groups - desirable, intermediate and undesirable. The segregation of species is accomplished by means of the plant list which accompanies the score card for classifying vegetation condition.

Percentage composition for each species and each group of species is computed on the basis of the average plant density index. Ordinarily it will only be necessary to compute percentage composition for the two or three most important key indicator species within each group, with the remaining species grouped and listed as "other" within their respective groups of desirable, intermediate and undesirable. This will suffice for classification of condition by the score card. Following this transfer and averaging of essential data for all transects within the cluster, the data are now ready for further consideration.

Classification of Current Range Condition.

Following the summarization of the transect cluster data, this information is utilized for classifying current range condition. This is accomplished by means of criteria specific to the range type being sampled and which for convenience are presented in score card form. Vegetation and soil are rated independently.

Classification of current vegetation condition. The first item to be rated by means of the vegetation score card such as shown in figure 4 is forage density index. The score for this item is entered directly on the transect cluster form after referring to the criteria presented in the score card for rating vegetation. The forage density index is utilized for this purpose in preference to the plant density index because it is more sensitive to changes caused by grazing.

The next item that is rated is composition, again by means of the score card, with the information that is summarized on the transect cluster form. The rating obtained is entered therein.

Similar procedure to the above is followed in rating vigor. It will be noted that in rating each element there is leeway of two or three points to permit a lower or higher rating as the summarized data together with judgment indicate as being the proper rating.

TRANSECT CLUSTER SUMMARY AND CURRENT RANGE CONDITION AND TREND RATING

Allotment Flagstaff District Musselshell Cluster No. 3

Date 9/7/50 By John Smith No. of Transects 1, 2

COMPOSITION

DESIRABLE *	Av. No. Hits	Av. % of total plant Density	INTERMEDIATE *	Av. No. Hits	Av. % of total plant Density	UNDESIRABLE *	Av. No. Hits	Av. % of total plant Density
FSC 12.0-9.5	13.2	19.3	PSE 2.0-1.0	1.5	5.4	ARE 5.0-4.0	4.5	10.2
Fid 10.5-15.0	12.7	18.5	Others 2.5-2.0	2.2		ANT 1.5-3.5	2.5	
Dun 10.0-6.0	8.0	11.7				Others - -		
Others 22.5-25.0	23.8	34.8						
Total		84.3	Total		5.4	Total		10.2

* List only key indicator species - group others.

SUMMARY OF ALL TRANSECTS IN CLUSTER

	Transect No. 1	2	3	Average
Bare soil	2.0	3.0		2.5
Erosion Pavement	1.0	-		0.5
Rock	2.0	1.0		1.5
Litter	21.0	25.0		23.0
Moss	3.0	5.0		4.0
Plant Density Index	71.0	66.0		68.5
Total	100	100		100
Forage Density Index	60.0	55.5		57.7
Ground Cover Index	80.0	92.0		91.5
Overstory	-	-		-
Understory	-	-		-

VIGOR MEASUREMENTS

Species	Transect No. 1	2	3	Average
Fsc	14.2	14.0		14.1
Fid	7.2	5.0		6.1

CLASSIFICATION OF CONDITION AND TREND RATING OF CLUSTER

VEGETATION	
Forage Density Index	9
Composition	15
Vigor	8
Total	32
Condition Class	Excellent
Current Trend	Up Down Static

SOIL STABILITY	
Erosion Hazard	15
Current Erosion	14
Total	29
Condition Class	Excellent
Current Trend	Up Down Static

Figure 3: Form for summarizing transect cluster data and for classifying Condition and Trend ratings obtained in Step Two.

*TENTATIVE CONDITION STANDARDS - MONTANA MOUNTAIN GRASSLANDS

SCORE CARD RATINGS FOR VEGETATION

Forage Density Index

55 to 65 hits = 9-10, 45 to 54 hits = 7-8, 35 to 44 hits = 5-6, 20 to 34 hits = 3-4, 19 to 0 hits = 0-2

Composition

**Desirable perennial grasses, weeds, shrubs make up 70 percent of plant cover. Festuca scabrella conspicuous 10 percent or more of composition 13-15

Desirable perennials dominant (50 to 69%). Festuca scabrella (may be absent) forms less than 10 percent of the vegetation 9-12

Desirable perennials 30-49% and with intermediate group of perennials making up over 60 percent of the composition . . 6-8

Desirable perennials 5-29%; intermediate species more abundant than desirables; collectively they make up from 35 to 60 percent of the composition 3-5

Desirable perennials less than 5%; low value undesirable species make up at least 65 percent of the cover 0-5

Vigor of desirable species - based on leaf length and growth form (criteria for summer of 1950 only)

Festuca scabrella		Festuca idahoensis	
Leaves 16"+	= 9-10	Leaves 6"+	= 9-10
Leaves 12-15.9"	= 7-8	Leaves 5-5.9"	= 7-8
Leaves 10-11.9"	= 5-6	Leaves 4-4.9"	= 5-6
Leaves 8-9.9"	= 3-4	Leaves 3-3.9"	= 3-4
Leaves less than 8"	= 0-2	Leaves less than 3"	= 0-2

Classification of vegetation condition score

Excellent (30 to 35)	Poor (15 to 19)
Good (25 to 29)	Very poor (0 to 14)
Fair (20 to 24)	

*Developed on Lewis and Clark National Forest, 1950, in connection with Range Condition and Trend Study.

**See attached species list.

Figure 4.--Condition standards for vegetation assembled in score card form for use in classification of data from transect clusters and to rate forage condition when delineating class boundaries in mapping condition.

Figure 4 - Cont.

Species List for Montana Mountain Grasslands

DESIRABLE SPECIES

Symbol	Scientific Name	Common Name
*Fsc	Festuca scabrella	Rough fescue
*Fid	F. Idahoensis	Idaho fescue
Fov	F. ovina	Sheep fescue
Cca	Calamagrostis canadensis	Bluejoint reedgrass
*Asp	Agropyron spicatum	Bearded bluebunch wheatgrass
Asu	A. subsecundum	Bearded wheatgrass
Asm	A. smithi	Bluestem wheatgrass
AGR	Agropyron spp.	Wheatgrass
CX	Carex spp.	Sedge
Dun	Danthonia unispicata	Onespike Danthonia
Din	D. intermedia	Timber Danthonia
STI	Stipa spp. (small needlegrass)	Needlegrass

INTERMEDIATE SPECIES

Ahi	Agrostis hiemalus	Winter bentgrass
*Pse	Poa secunda	Sandberg bluegrass
Ppr	P. pratensis	Kentucky bluegrass
Msq	Muhlenbergia squarrosa	Mat muhly
Ker	Koleria cristata	Junegrass
GER	Geranium spp.	geranium
CAST	Castilleja spp.	Paintcup
TRI	Trifolium spp.	Clover
AGO	Agoseris spp.	Agoseris
Ala	Achillea lanulosa	Western yarrow
Bsa	Balsamorhiza sagittata	Balsam root
O	Other	Unknown plants

UNDESIRABLE SPECIES

GEU	Geum spp.	Avens
CLE	Clematis spp.	Clematis
VIO	Violet spp.	Violet
TAR	Taraxacum spp.	Dandelion
AST	Aster spp.	Aster
SOL	Solidago spp.	Goldenrod
*ANT	Antennaria spp.	Pussytoes
Afo	Arnica foliosa	Arnica
LUP	Lupine spp.	Lupine
*ARE	Arenaria spp.	Sandwort
*Bte	Bromus tectorum	Cheatgrass brome
*Afr	Artemisia frigida	Fringed sagebrush
Agn	A. gnaphalodes	Cudweed sagebrush
*Atr	A. tridentata	Big sagebrush

*Key indicator species.

All three items are then totaled and the proper adjective rating for current vegetation condition entered directly on the transect cluster summary form.

The criteria for rating the various elements of vegetation that are presented in the score card are based on the results of range research and critical observation of the characteristics of many condition situations within a specific range type. Hence such score cards should only be prepared and utilized after careful joint consideration by research and administrative personnel. These criteria may be subject to change in the future but only as increased knowledge of the range type warrants. Even though the condition standards may change as we secure more adequate criteria, the history of the site as obtained in Step One is always available for future reanalysis.

However, in the interpretation of the data on vigor, a new set of guides are computed for each subsequent year of examination in order to eliminate differences which might otherwise arise from the variable effects of weather on plant growth between different years. These guides are prepared only by someone who has had prior training or with the guidance of Research. Also if the work is carried on season long, separate guides or at least a field check on the initial guides will be necessary for the middle and late parts of the season in order to adjust them to current plant growth.

Guides on vigor for purposes of this classification are quickly and easily set up for a specific range type by measuring a minimum of 50 plants of each selected species on a range which has been subject to light grazing use for the past decade. If such areas are not available large fenced exclosures or areas with a long-time history of moderate use may be selected as alternates. Selection of the 50 plants for measurement should be made by random pacing as previously described for plants measured on the plots circumscribing the transects. Measurements are recorded to the nearest half inch and these data are then arranged from the longest to the shortest leaf length measurements and divided into five equal subgroups so that each subgroup makes up a proportionate part. The range in values for each of these subgroups is used as the basis for the criteria set up in the vegetation score card and for later rating of the data collected at each transect cluster.

One of the main requirements for accomplishing an effective job in the collection and interpretation of data on vegetation is accurate plant identification. The examiner need not be a highly trained taxonomist, but he must be able to recognize the principal species within a major plant community. In the vegetation score card presented, 37 species are listed for this one range type and accurate recognition of this number would for most situations suffice as a record for following trend in vegetation.

Classification of current soil stability. As shown on the score card for soil, figure 5, two major categories of information are recognized in rating current soil stability. The first is "erosion hazard index" and the basic data for rating this element are those obtained on the ground cover index. This was defined as 100 minus the number of hits on bare soil. In other words it is the total number of hits on erosion pavement, rock, litter, moss and vegetation. It is these elements which serve to prevent rain drop splash erosion and whenever the ground cover index is reduced in amount erosion is that much more likely to become accelerated.

Current soil erosion is rated by means of the criteria presented in the card for rating soil. The rating is made only after critical observation of conditions within and between (if they should be separated) each of the 100x150 foot plots which make up each transect cluster.

The ratings obtained on erosion hazard and current erosion are entered, totaled on the transect cluster summary form and classified with the proper adjective rating.

Estimation of Current Trend in Range Condition.

Having interpreted the data and rated the condition of both vegetation and soil stability, the examiner then estimates (if criteria are available) current trend of each of these. As in classifying condition this is done directly in the field only after critical observation of trend indicators within each transect plot making up the cluster. As a guide for accomplishing this rating, it is suggested that criteria be presented in score card form such as shown in figures 6 and 7 for trend in vegetation and soil stability.

Estimation of current trend in vegetation. It will be noted that criteria for judging trend in vegetation are classified by condition classes. This segregation of criteria is made because the earmarks of an improving or deteriorating range will vary with the condition class. The criteria for these earmarks are based mainly on plant vigor, the progress of the vegetation towards a more stable and productive cover, and utilization of the range. The latter item is given less weight than vigor since the current establishment or lack of establishment of new plants reflects the accumulated effect of recent range use.

Upward trend is indicated by an excess of positive points and downward trend by an excess of negative points. Static or trend that is indefinite or not apparent is indicated when positive and negative points are balanced. The score on trend does not measure rate of trend but is intended only to indicate the direction of change within the previously determined vegetation condition class. The adjective rating is checked in the space provided on the transect cluster summary.

TENTATIVE CONDITION STANDARDS - SOUTHWESTERN REGION
SCORE CARD RATINGS FOR SOIL STABILITY

Erosion Hazard Index (Rate from 0 to 15 on basis of ground cover index)

90-100 hits = 14-15, 64-76 hits = 10-11, 37-49 hits = 6-7, 10-23 hits = 2-3
77-89 hits = 12-13, 50-63 hits = 8-9, 24-36 hits = 4-5, 0-9 hits = 0-1

Current Erosion on Cluster Site (Rate from 0 to 15)

No evidence of soil movement: plant and litter cover effective in protecting soil; runoff is clear; no piling up of litter behind plants, gullies if present completely stabilized and healed. = 13-15

Soil movement slight: but difficult to recognize: may be evidence of past accelerated erosion but now fairly well stabilized; plant and litter cover appears effective in protecting soil; plant pedestals few or sloping sided and stabilized; rills, alluvial deposits and gullies if present are nearly healed; some litter may be dammed against vegetation, forming miniature alluvial fans; trampling displacement slight, no noticeable compaction; rodent activity normal. = 10-12

Soil movement moderate: definitely discernible, may be accelerated in spots and stable elsewhere; plant cover and litter effectiveness doubtful in protecting soil; considerable bare soil; many plant pedestals, some steep sided; erosion pavement forming with occasional exposed pebbles; occasional alluvial deposits and rills present; gullies if present, not raw; trampling displacement and compaction noticeable, but not excessive; rodent activity may not be noticeable; runoff murky. = 7-9

Soil movement advanced: plant cover and litter definitely not effective in preventing soil movement; considerable bare soil; steep sided plant pedestals numerous; stony soils with well formed erosion pavement; rills, and alluvial deposits common; gullies, if present, with raw sides; trampling displacement and compaction common; rodent activity may be excessive; runoff muddy. = 4-6

Soil movement severe: plant cover inadequate, litter lacking; subsoils exposed in many places; pedestals of stronger perennials almost completely eroded away; erosion pavement complete on stony soils; rills and alluvial deposits numerous; gullies, if present, with raw sides; rodent activity generally severe; runoff from summer storms flashy and muddy often causing miniature mud flows. = 0-3

Classification of Soil Score

Excellent	(27 to 30)	Poor	(9 to 14)
Good	(21 to 26)	Very Poor	(0 to 8)
Fair	(15 to 20)		

Figure 5.--Condition standards for soil stability assembled in score card form for use in classification of data from transects and for rating soil stability of the site when delineating class boundaries in mapping of forage condition.

TENTATIVE TREND STANDARDS FOR PONDEROSA PINE BUNCHGRASS
(Colorado front range)

TREND IN FORAGE CONDITION	(Circle pertinent items and add) Positive	Negative
FIRST OR SECOND CONDITION CLASS (Good or excellent)		
1 a. Mountain muhly, Parry danthonia, little bluestem, needle-and-thread in good or excellent vigor.	2	
1 b. Mountain muhly, Parry danthonia, little bluestem needle-and-thread in fair or poor vigor.		2
2 a. Utilization of dominant species does not exceed proper.	1	
2 b. Utilization of dominant species does exceed proper		1
3 a. Browse in healthy condition.	1	
3 b. Browse hedged or dying		1
THIRD CONDITION CLASS (Fair)		
1 a. Mountain muhly, Parry danthonia, little bluestem needle-and-thread invading bare spots or replacing species that are most common on range in fair or poorer condition or Kentucky bluegrass in good vigor.	2	
1 b. Mountain muhly, Parry danthonia, little bluestem, needle-and-thread in low vigor with no invasion of bare spots of these species. Increases of fringed sagebrush, snakeweed, groundsel, low sedges, or sleepygrass may be occurring.		2
2 a. Utilization of invading better species does not exceed proper.	1	
2 b. Utilization of invading better species exceeds proper.		1
3 a. Browse recovering from past grazing damage.	1	
3 b. Browse hedged, dying or dead; inferior species if present closely grazed.		1
FOURTH CONDITION CLASS (Poor)		
1 a. Wheatgrass, Kentucky bluegrass, blue grama, western yarrow, green needlegrass or geranium invading bare areas.	2	
1 b. Low value species including fringed sagebrush, pussytoes, sleepygrass, snakeweed, cheatgrass brome, fleabane, etc., increasing.		2
2 a. Utilization doesn't exceed proper on Kentucky bluegrass blue grama, wheatgrasses, or other grasses characteristic of better range conditions.	1	
2 b. Utilization exceeds proper on Kentucky bluegrass, blue grama, wheatgrasses or other grasses characteristic of better range conditions.		1
3 a. Browse recovering from past overgrazing.	1	
3 b. Browse hedged, dying or dead Inferior species closely grazed		1
FIFTH CONDITION CLASS (Very poor)		
Invasion or thickening of any species characteristic of better range condition	1	

Figure 6. Score card used to estimate trend in forage condition.

RANGE TREND SCORE CARD PACIFIC NORTHWEST REGION
(Bunchgrass range)
TREND IN SOIL STABILITY

	Check pertinent item and balance	
	Plus	Minus
GOOD (OR EXCELLENT) CONDITION		
Cover of litter is being replaced each year	3	
No visible accelerated erosion	2	
No trampling displacement occurring	1	
Rodent activity normal or below	1	
Litter is not accumulating		3
Plant cover breaking up and exposing small spots of bare soil		2
Trampling displacement occurring		1
Rodent activity increasing		1
FAIR AND POOR CONDITION		
Litter is increasing in bare spots between grass clumps	2	
Gullies, if present, healing, with sides well covered with perennial grasses	2	
Rills and alluvial deposits being stabilized with perennial grasses	2	
Trampling displacement insignificant	1	
Pedestals of Agsp, Koer, Feid healing on sides	1	
Litter is not accumulating and soil surface is being exposed		2
Gullies not healing over with perennial grasses		2
Rills and alluvial deposits not being stabilized with perennial grasses		2
Trampling displacement noticeable		1
Pedestals of Agsp, Koer, Feid, steep sided		1
VERY POOR CONDITION		
Anlu, Acla, Pose, Sihy, Melica, Brma, annuals and mosses are increasing and covering up bare soil surfaces	2	

Figure 7 - Example of score card used to estimate trend in soil condition.

Estimation of current trend in soil stability. As in the case of vegetation, determination of the direction of trend in soil stability requires that it first be classified as to current condition because the earmarks of an improving or a deteriorating range will vary between condition classes. The criteria for these earmarks on trend in soil are based mainly on the signs of litter accumulation, degree of activity of erosion in rills and gullies, plant pedastaling, and trampling displacement. Following the balancing of positive and negative ratings the correct adjective rating is checked in the space provided on transect cluster summary. This adjective expression is intended to indicate the direction of apparent trend and not the rate of change.

Transect Cluster Records to be Used for Determination of Future Trend in Condition.

The transect cluster summary, together with the individual transect forms, and the condition and trend score cards used in the field work are intended to be maintained as a permanent, long time record. These records will serve as documentation which when compared with records obtained similarly in subsequent years will be the principal means for determination of trend in vegetation and soil within the intervening period. Summarization and interpretation of the data by Step Two directly in the field avoids the pitfall of deferring this as an office job for spare time hours which seldom seem to arise. Moreover on the ground interpretation is ordinarily more thorough.

In the follow up work in later years, the initial or preceding record of each transect cluster is taken into the field and after the re-examination and analysis of new data, the two sets of records are directly compared. This should be carefully done item by item in order to assure that any conclusions arrived at with regard to trend are correct. Confidence in these findings is essential for concluding whether or not changes similar to those found on the transect clusters have likewise occurred elsewhere within the condition situation which they sample.

For most range types the greatest changes in vegetation to be expected will occur in floristic composition, the forage density index and vigor. In looking for change in composition the average number of hits should be watched as well as the percentage because the latter at times may be deceiving. If the trend is upward the desirable or intermediate species ordinarily will have increased and depending on the original condition the undersirable species may have decreased. Conversely if the desirable species on a range have decreased (unless the result of drought) one can well assume a downward trend in vegetation condition. Similarly on ranges in fair and poor condition a decrease of the intermediate species would indicate downward trend unless offset by an increase in desirable species. An increase in either would ordinarily be improvement.

Changes in the forage density index can be expected to occur as in the case of the desirable and intermediate species since it is an expression of the abundance and amount of the plants making up those groups.

The measurements and other observations on plant vigor are also important to observe. Improvement in vigor is usually one of the first signs of an upward trend. On the other hand the effect of too heavy grazing (and drought) is first reflected in lowered forage production as brought about by poor vigor. Plants become low in vigor before dying and being replaced by other and often undesirable plants.

In the evaluation of changes in soil stability, the trend in soil erosion hazard is undoubtedly an important item to watch. This is because an increasing amount of ground cover brings about a lowering of the soil erosion hazard whereas a decrease in cover will ordinarily increase the hazard. Ground cover is an expression based on actual measurement of the transect. The item of current erosion requires an evaluation of many indicators of soil movement and disturbance, all of which are based largely upon the judgment of the field examiner and so are not so readily adapted to direct measurement.

As further substantiation of changes that may have occurred within the transect cluster sites the numerical ratings which are recorded on vegetation and soil should be compared. This is particularly true whenever the criteria for making these classifications are considered to be sound by research and administrative personnel. One advantage in the use of numerical ratings as additional evidence of change is that it avoids broad "stair step" grades which must be assigned with purely adjective ratings such as "good" and "fair." By the score card method the examiner can with reason currently grade condition within a condition class and without hestitancy grade the condition in borderline cases where the condition is not clear-cut between condition classes.

STEP THREE

Step Three consists of two key photographs (figure 8, 8a) which form a visual record, in part at least of the elements measured and observed in Step One. The camera is set up at a height of about 42 inches directly over the 0.0 or the 99.5-foot mark (whichever is best for showing the range type) and two photos are taken.

1. A general type photograph taken with the opposite end of the transect centered in the background. This photograph is necessary for showing changes, whenever the photo is repeated, which may take place in the aspect of the type. It is also a helpful aid in relocation of the sampling area.

2. Close-up of a 3x3 plot taken obliquely and from the same photo point as the general photo. The plot is delineated by striped rods or by two 6-foot folding carpenter rules. It is centered on the transect line with the nearest side of the plot 3.5 feet from the photo point. The close-up photo forms a record which often reveals changes in plant cover and movement of soil and other changes whenever repeated.

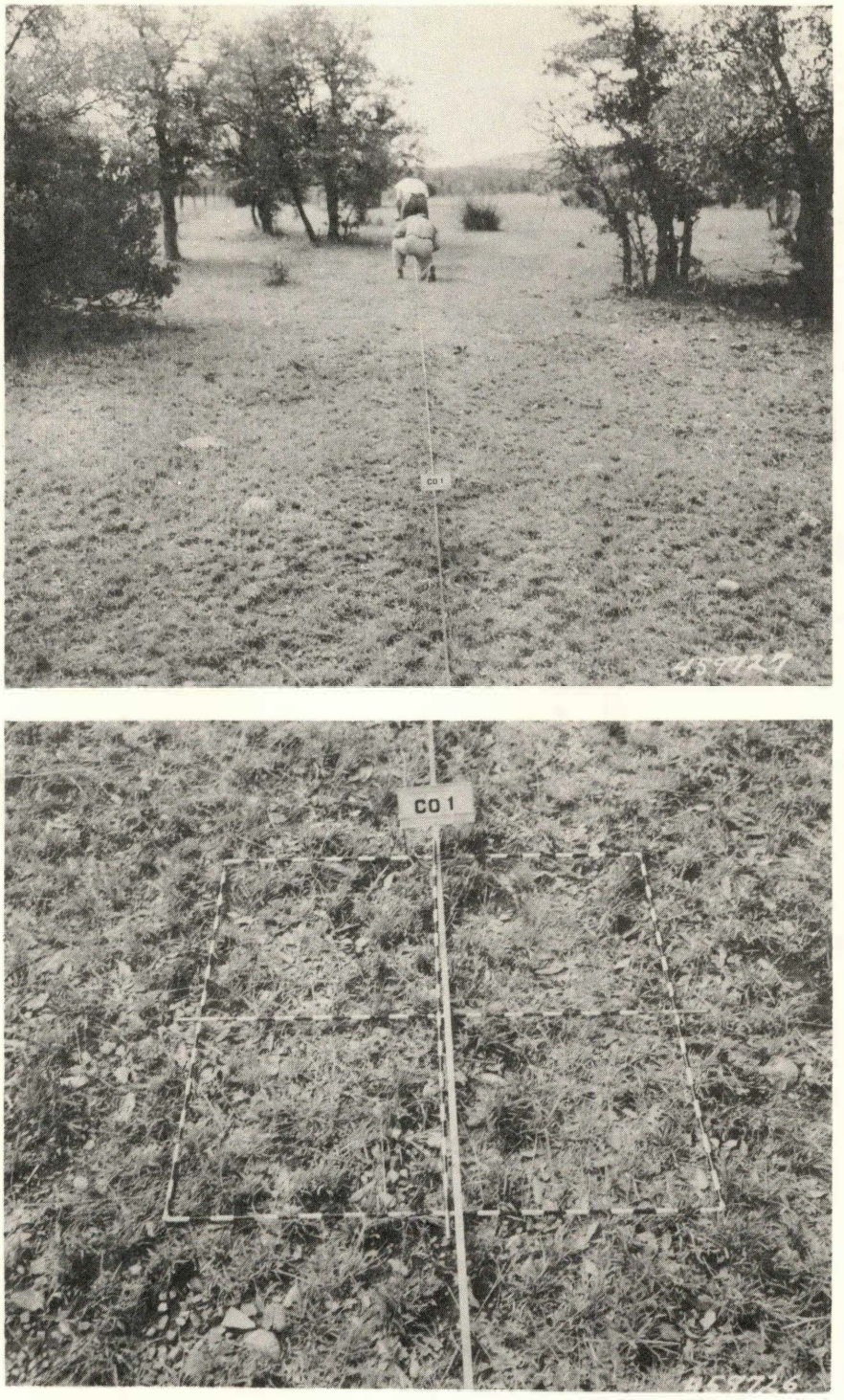

Figure 8. Step Three of the 3-Step Method consists of a general type photo and an oblique close-up of a 3x3 plot taken from one end of the transect line. Mixed grama-oak savannah woodland, Coronado N. F., Arizona.

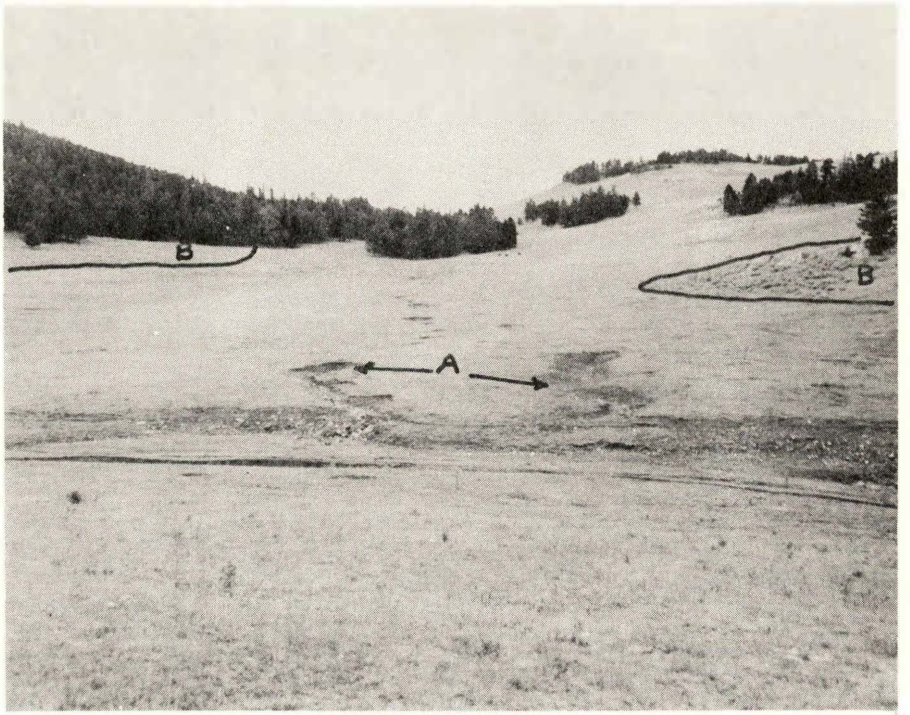

Figure 8a. Noteworthy happenings can also be recorded by supplementing photograph taken from the transect photo point, such as gullies indicated by "A" and the advent of sagebrush colonies shown here as "B". Mountain grassland, Lewis & Clark National Forest, Montana.

If deemed desirable, additional photographs may be taken from the same photo point or other established photopoints for recording special situations such as hedged browse and erosional features.

Initial photographs and retakes, although a one-man job, requires special training and aptitude.

APPLICATION OF THREE STEP METHOD ON AN ALLOTMENT BASIS

The maintenance and attainment of satisfactory range conditions on national forest allotments is the responsibility of administration, represented on the ground by the district ranger. Permittees whose livestock graze the range are also vitally concerned in achieving satisfactory trends in range condition. The range management necessary to attain satisfactory trends in condition is a cooperative undertaking. Accordingly, it is suggested that on allotments where one or two permittees are involved that they be invited to take part in the initial as well as later follow up record taking in order to secure a better mutual understanding of just what has occurred. On allotments where several permittees own the livestock they might wish to have a committee to represent them. Permittees who wish to do so should be encouraged to assist in the actual record taking. Copies of the complete record should be available to them at the District ranger office for their consideration if they so desire. It is believed that conduct of the work in this manner will also lead to greater mutual confidence in the findings as applied on a range unit basis.

The success with which the study of range condition and trend is carried out on a range unit basis depends on (1) adequate training of personnel, (2) the care and accuracy with which the initial and subsequent records are taken and analyzed and (3) the soundness of the conclusions arrived at as to trend. Some of the personnel will need help in taking the photographs called for in Step Three. Many rangers will probably require the assistance of a specialist in the interpretation of data and the significance of certain changes which may occur. This aid and assistance should always be readily available from research and administrative personnel whose knowledge and experience fully qualify them for this job.

Procedure in application of the Three-Step Method on an allotment basis consists of: tentative classification and preliminary mapping of range condition, installation of transect clusters, final field check of the map and final office work.

PREPARATION OF THE MAP

One of the major findings in the studies carried out in the application of the Three-Step Method on an allotment basis is that the mapping of types by tentative condition classes is a necessary prelude to sampling. Mapping simplifies the job and reduces the cost of sampling an allotment for trend, because it restricts the sites to be sampled by transect clusters to those areas which can be expected to change because of management. Also it is only through areas that have been closely studied, such as transect cluster sites, that we are afforded a critical basis for finally classifying the condition of larger land tracts.

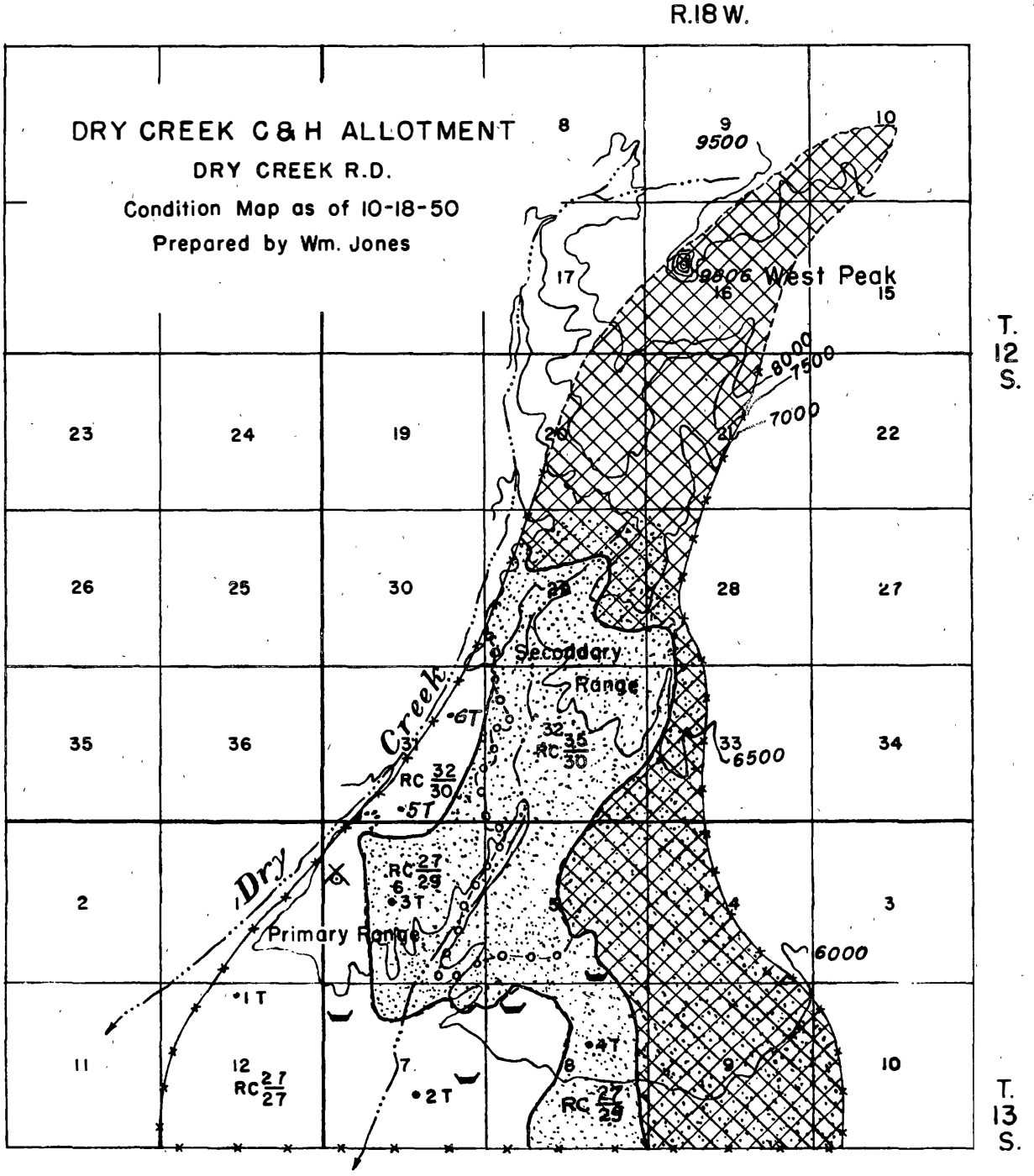

Figure: 9 —Map delineating unusable areas, primary and secondary range areas, vegetation types, condition classes, and location of transect clusters.

Mapping not only assures a more careful consideration in the selection of transect sites but also helps assure that the overall situation with respect to current condition and apparent trend within an allotment are neither minimized nor magnified. Mapping by tentative condition classes shows at a glance the magnitude and relationship of the various situations and consequently is often in itself suggestive of changes in management which if made will ultimately bring about over-all improvement in condition of the range unit. A map is also necessary for showing the location of the transect clusters and is essential for later field location in follow-up measurements.

In following the trend in condition of one allotment over a period of years, the average for the allotment or even for a major type within it has little significance. Take the case of the Flagtail allotment 2/ in Oregon, where the ponderosa pine type makes up the major portion of the area. Under moderate grazing use of the allotment as a whole the ponderosa pine type will be lightly utilized while the meadow and sagebrush-bitterbrush types are being more heavily grazed. To average the three types as to changes indicated by periodic measurement of transect clusters would be meaningless. This is because if the ponderosa pine type, for example, is in good condition and the others in only fair condition, the forage on the ponderosa pine type may not show any improvement while the other two types could be improving. To average all three would minimize the real improvement on the allotment. On the other hand if most of the range is in unsatisfactory condition, the forage in the ponderosa pine type might show improvement while the other types failed to do so. Similarly it would be misleading to average the change in condition within a single type . For example, parts of the meadow type may be in good condition and the cover of Nebraska sedge actually improving, whereas at the same time adjacent drier parts are being damaged. Mapping the condition situation within the vegetation types of the usable range helps prevent any attempt to average the good with the poor and also serves as an estimate of the size of the areas affected by any change which may take place.

Ordinarily the mapping will be done on an extensive basis, requiring a minimum expenditure of time. The map may be prepared as an overlay to the range inventory map or on a separate base whichever is most convenient. Prior to the field work all available and essential data should be entered insofar as possible. This should include sketching within the usable range the vegetation type lines on a broad plant community basis from existing range survey maps. Other essential data include: allotment and management unit boundaries, fences, stock waters, fenced exclosures, closed areas, etc. In figure 9 is shown an example of the map. Its preparation required 1-man day for the preliminary mapping. It was prepared without the aid of a range inventory map. The mapping is done on the best available map on a scale of one inch equals one mile, or larger

Whenever range inventory maps are available to serve as a base for the overlay they should be used. Aerial photographs on which the ground control has been established are preferred for the field work. If aerial photographs are not available, planimetric maps or good topographic maps can be used. When available, aerial photographs can be used as a guide for sketching type and condition lines on planimetric maps

2/ Progress report on Flagtail Condition and Trend Methods Study. Prepared by Joseph F. Pechaneo, dated February 19, 1951, in files, Pacific Northwest Forest and Range Experiment Station, 40 typed pages.

The following categories of range are recognized in mapping:

1. Usable range is that which has value for and can be safely grazed by livestock. It is divided into primary range and secondary range. As the guide in separation of primary range from secondary range, research findings on factors affecting grazing use such as Glendening's 3/ work in the Southwest should be used.

2. Primary range is that which furnishes the bulk of the forage to range livestock and includes the most accessible parts of the allotment such as meadows, open parks, canyon bottoms, and openings within brush and timber types. Ordinarily these primary range areas will be overutilized before cattle intensively graze other parts of the allotment. They comprise the parts of the range which are most likely to reflect change in condition. Accordingly, the primary range area is where the line transect clusters should be established.

Only the broad general plant communities such as mountain grassland, meadow, ponderosa pine, and aspen are shown on the map. These are subdivided as to condition class boundaries.

Five condition classes (excellent, good, fair, poor, and very poor) for vegetation and soil are recognized by the same criteria utilized in score card form to classify the transect cluster data. If standards for judging condition are not set up in score card form and defined as to condition classes, the different condition situations will have to be mapped on the basis of judgment recognizing broad but distinctly different condition situations.

Judgment of density and composition which is entailed in application of the condition score card for appraising the condition class area can be checked by means of the paced transect. This is accomplished by attaching the loop or ring instrument to a cane, taking 100 full paces through the area, with an observation recorded at the end of each pace. Readings are recorded by a simple dot tally but otherwise summarized as in the case of Step One.

In most instances primary and usable range will be determined on the basis of the kind of livestock currently grazing the range and under existing management and improvement facilities. Where range is used in common, as by both cattle and sheep, usable areas should be classified separately as to each kind of livestock. Also, the delineations of primary and secondary range areas are subject to change in size because of later range improvements such as the construction of stock trails and development of stock water within the secondary range area.

3/ Glendending, George E. Some Factors Affecting Cattle Use of Northern Arizona Pine-Bunchgrass Ranges. S. W. Forest & Range Experiment Station. 1944. Res. Rpt. No. 6, 9 ;;. illus. (proc.).

3. Unusable areas are those which are of no value for livestock use because of steep topography, barrenness, and dense timber and areas which have been closed.

4. The secondary range area is comprised of the remaining land areas after delineation of the primary range and unusable areas. On range grazed by cattle these are the areas without permament stock water; i.e., lands beyond one mile from water in rough topography or 2 miles beyond water in rolling or level terrain. They may be grazed occasionally by drift livestock, but for the most part it will be light use whenever the primary range is properly stocked. The vegetation types or condition classes within this category are not delineated.

INSTALLATION OF TRANSECT CLUSTERS AND FINAL MAP CHECK

Immediately following the preliminary mapping of the allotment, the primary range areas are sampled with permanently established transect clusters measured by the Three-Step Method. The location of the sites for the transect clusters established on the allotment are shown directly on the map. Notes on the exact location of each transect and the end from which measurements start, are entered directly on the back of the transect form.

The clusters serve as permanent "bench marks" or definitely marked points to which subsequent examiners can always return for periodic reexaminations. They also serve as inspection points for field supervisors to check during a range inspection. It is unlikely that the trend as determined by later remeasurement and comparison of data on clusters will be in one direction and that of the condition class area in the opposite direction. If such should occur in the future, the cause should be determined and if necessary additional clusters be established.

The transect clusters also serve as sites for making the utilization check at the end of the grazing season. This record especially on controversial allotments should be made every year forming a continuous year to year record. In situations where there is no special controversy, obtaining of a utilization record is optional. Procedures to be followed in making the utilization check are those outlined in the Regional Range Management Handbooks.

Time Required for Installation and Measurement of Transects.

The time required for initial installation, measurement and analysis of data in the field will vary largely with the difficulty of travel, the complexity of the vegetation, weather and the aptitude and ability of the men doing the job. Some indication as to the time required is available from the experience gained in connection with the studies of application of the Three-Step Method on an allotment basis during the summer of 1950. In the Southwest on mixed grama woodland range, grazing staffmen and forest ranger personnel were largely involved and the men worked in two man crews. The selection of sites, installation of transects, measurement and analysis of data from these transects, the taking of photos, etc., required two and one-half man-days including travel time largely by car for the complete record on three clusters of three transects each.

In Oregon, on meadow, open forest and sagebrush-bitterbrush range types, the selection and installation of transect clusters (three transects each) had been previously accomplished. The men, working in two-man crews, one of whom was a ranger, were not familiar with the location of the transect cluster sites and had to locate them by means of locations indicated on aerial photos and a map of the allotment. Hence this procedure simulated in large measure what would be required in time by different men for finding the transects in follow-up work. The allotment was fairly well traversed by roads but required walking a distance of one to two miles in several instances. The average time required was as follows: travel from cluster to cluster and to and from headquarters 34 man minutes. Laying out the tape and measurement of each transect varied from 32 in the open forest to 51 man minutes in the meadow type which was more complex as to species and of greater density. The sagebrush bitterbrush type required 40 man minutes per transect. The analysis and classification of condition called for in Step Two required about the same amount of time per transect in each type - the average being less than 30 man minutes. Photography, time for general and close up per transect was 13 man minutes. Inclement weather was encountered every day of the study.

In Montana, on open easily accessible mountain grassland which is of high density, with many species difficult to identify, Step One required about 50 man minutes, Step Two about 25 and Step Three 15 man minutes per transect line. District ranger personnel were involved.

The time required in all of the studies carried out on an allotment basis in the regions was not considered prohibitive.

Final Field Check of the Preliminary Mapping

The ratings obtained on vegetation condition and soil stability at the transect cluster sites are used as a base for the final rating assigned to each condition class area that is delineated within the primary range area. On this basis it may be necessary to modify the original tentative rating assigned to a condition class area. However, the final rating for a condition class area may vary a few points above or below the average of the transect clusters because various evidence not found on the sites sampled by the transect clusters may warrant a slightly different rating. For example, current erosion may be more pronounced outside than inside the cluster sites and the soil stability rating would be accordingly reduced. The assignment of final ratings to each condition class area should also be accompanied by whatever changes in boundaries of the types and condition situations as deemed desirable by continued inspection of the range during the course of the field work. This comprises the final field check of the preliminary mapping.

FINAL OFFICE WORK

Although the bulk of the summarization of data and its interpretation is accomplished directly in the field, there still remain several jobs which are best completed in the office. These include final preparation of maps, an allotment summary, and filing of data.

Final Map Preparation

Final map preparation includes the transfer of the essential information from the aerial photos (if these have been used) to the base map. Ordinarily it will not be considered necessary to color the maps. Simple cross-hatching of the unusable range as in figure 9, helps focus attention on the usable parts of the area.

The location of permanent transect-line clusters will be shown on the map in black ink with a "T" and the number of the cluster appended, i.e., "3T."

The rating for the condition class within the type will also be shown.

For example, RC $\frac{13}{14}$ (13 vegetation-condition score; 14 soil-stability score).

Allotment Summary of Range Trend Data.

Following the final map preparation, the numerical ratings for current vegetation and soil stability condition which have been recorded on each transect cluster summary form are entered into the Allotment Summary such as figure 10. Field notes on evaluation of changes in vegetation and soil secured at each time of re-measurement should be saved and clipped or filed with this form. This form is a permanent long-time record, providing space for summarization of data in subsequent years. Trend is indicated for each new year of measurement by comparison of the numerical ratings of vegetation and soil condition with the previous year of measurement. The real basis for such rating is the field interpretation of the basic data obtained in Step One, which procedure has been previously described.

Ordinarily the transects would be remeasured every 2 or 3 years and the mapping at longer intervals of 4 to 6 years time.

Filing of Data

The data and maps, when completed, will be marked "Permanent Record--Do Not Destroy." They will be filed allotment by allotment in the G-MANAGEMENT folder for that allotment in the district ranger's files. Copies will be made for the supervisor's or the regional forester's files only as the occasion demands.

Other essential data to file in this same folder include the regular National Forest Allotment Summary on which are entered the actual use as to numbers and kind of livestock and Seasons of use, together with information on construction of range improvements, reseeding and noxious plant control work, unusual build up of big-game numbers, years of over or under utilization, notes on precipitation, livestock weights and other production data, etc. These records are essential for the explanation of the causes of ultimate trend.

The data contained within this folder will eventually form the historical record of the trend in range conditions and the essential information explanatory to why these trends have taken place.

ALLOTMENT SUMMARY OF RANGE TREND DATA

Allotment _____ District _____

YEAR OF RECORD

Cluster Number	Range Type	Initial Range Condition Class	19__		19__		19__		19__	
			Veg.*	Soil*	Veg.	Soil	Veg.	Soil	Veg.	Soil
				**						
			Trend							
			Trend							
			Trend							
			Trend							
			Trend							
			Trend							
			Trend							
			Trend							
			Trend							
			Trend							
			Trend							

* Enter ratings obtained on transect cluster form for vegetation and soil stability; i.e. 3OV 27S.

** Rate trend as up, down, static, after comparison of condition ratings with previous year measurements.

Figure 10. Form used to assemble and maintain range trend data for several years on an allotment.

APPLICATION OF 3-STEP METHOD ON ALLOTMENTS WHERE CONDITION STANDARDS ARE LACKING

Several of the western regions do not as yet have well developed condition standards for the more important plant communities. In such situations there will occur such questions as segregating and grouping the plants into the three categories of desirable, intermediate and undesirable species, classification of condition of vegetation and soil stability and the estimation of current trend; as required in Step Two of the method. The first of these does not present an insurmountable problem and should never be a valid reason for not undertaking the study of trend on a range unit because most forest rangers and stockmen know what most of the desirable and undesirable are. The classification of condition and the estimation of current range trend may have to be considered on a preliminary basis or some phases actually deferred. A situation similar to this was encountered during 1950 in application of the 3-Step Method to the Flagstaff allotment on the Lewis and Clark National forest in Montana. It was met by careful study in the field of various condition situations found on the allotment, and the application of knowledge gained elsewhere in this plant community. A week's field work was required for the preliminary standards, which are summarized in figure 4. The job was accomplished through the joint efforts of research and administrative personnel. No attempt however was made to prepare criteria for estimation of current trend in vegetation and soil on this allotment. In such situations it is believed that trend can better be determined with the actual changes that occur on each of the transect clusters over the years.

Ordinarily 1 to 2 man years is required to develop adequate criteria for classifying condition and soil in a single range type and should always be utilized whenever available. Criteria developed "on the spot" as in the case of the Flagstaff study should be subject to additional careful recheck by research and administration whenever the opportunity and need for doing so occurs. Even though initial adjective and numerical ratings be incorrectly assigned, the original basic field data obtained in Step One if properly recorded and its analysis and other classification in Step Two is easily re-checked later if the need for doing so is subsequently indicated by newly developed criteria.

SELECTION OF ALLOTMENTS FOR APPLICATION OF METHOD

The application of the 3-Step Method, or any other method for that matter, at an acceptable statistical level of sampling for each and every one of the some 10,000 grazing allotments in the West is not feasible with present funds and personnel. Nor is it necessary if we recognize that on most ranger districts, allotments can be segregated into two or three groups. For example: one group of allotments, where range conditions and utilization are generally satisfactory and there is little need for anything more than routine inspection; a second group where range condition is unsatisfactory and trend may be uncertain and where more detailed information is needed than would be supplied by the ordinary inspection; and a third and usually small group of allotments where condition and trends are highly controversial and where the most factual record attainable is required. To meet these three situations, the method applied for following trend must be flexible and supply information whose continuity will not be broken by later adaptations. Some allotments listed now as noncritical may later become so, necessitating a more careful check. The 3-Step Method meets this requirement of flexibility.

In the first group of allotments mentioned above, it would seem advisable to apply the 3-Step Method to a very few, carefully selected representative allotments. This might include any which are designated as demonstrations of good management. In the second group of allotments, a larger number of representative allotments would be sampled, and in the third group, the number of allotments selected would also be limited but a still larger proportion would be sampled. As an example, a ranger district might have 30 allotments involved but only four or five of these might be sampled (and not all of these in the first year) with one allotment in the first group, one or two in the second, and one or more in the third if there should be a third group on the district. On most ranger districts and forests it would not be a prohibitive workload for the ranger, with proper supervision from the grazing staffman to complete the initial installation and secure the necessary field data called for in the 3-Step Method on two or even three allotments per year. Two rangers might even work as a team to get the initial installation accomplished on their districts.

Much the same way of assigning priorities could be set up for a forest with respect to ranger districts and even for an entire region with respect to individual national forests. Assignment of priorities in this manner will permit a more effective allocation of time by grazing staffmen and personnel from the Division of Range Management.

TRAINING AND OTHER REQUIREMENTS

Training in the field of all personnel expected to take part in establishment and subsequent record taking by the 3-Step Method is a necessary prelude in initiation of the work on a range unit basis. In addition to instruction in methodology and use of aerial photos in mapping, training is needed in ecological perception and plant identification. In plant identification personnel must be able to identify the bulk of the important key indicator species not only by the floral parts but also by the more difficult to recognize vegetative characteristics.

Following proper training the complete job - mapping, measurement of transects and field analysis of data and final office work can be accomplished by one man. However, the initial installation and measurement of transects especially in shrub types and whenever it is difficult to get the tape taut and straight is most efficiently accomplished by a 2 man crew - one of these need not be highly skilled in techniques.

Just how large a part the average ranger can take is a moot question. It will no doubt vary greatly between ranger districts. There is general complaint in all regions that the ranger's work load is now so great that time is not available for adequate yearly range inspections and the maintenance of necessary allotment records. And yet, the ranger should take an active part in the condition and trend work. After all, he is the land manager responsible for action taken, and it is he who must put to use the information on condition and trend. In order to have the ranger take an active part in the work, there will need to be, in some instances at least, rather drastic shifts in work loads, activities and responsibilities.

Obviously everyone interested or concerned should become thoroughly familiar with the methodology and objectives of the work. It would be helpful if field demonstrations would be arranged wherever possible with joint participation of administrative personnel and permittees. In addition, interested personnel of other public range administering agencies, state colleges, and experiment stations as well as non-permittee stockmen should be encouraged to participate in these field demonstrations.

RESPONSIBILITY FOR ACCOMPLISHMENT OF THE WORK

The assignment of duties, responsibilities and authority of personnel connected with the condition and trend work are similar to those involved in connection with "range resource inventories." For the condition and trend job these should be as follows:

Chief

The function of the Washington office will be to correlate and obtain uniformity as to range condition standards insofar as possible between the various regions; to inspect samples of the field work to see that it is being done in accordance with the general standards and specifications, to provide funds for special projects; and where regions request it or appeals are pending to review the records of controversial cases to see if the results and interpretation of data on trend are on a sound basis.

Regional Forester

There are at least two alternatives for conducting the condition and trend work within a region. (1) On a special project basis (as in the case of range inventory), (2) on a local forest basis. The project basis has much to commend it--such as assignment of fully qualified and best technically trained men to do the job, assurance of general uniformity in work standards throughout the region and attainment of closer contact by regional office men with the range problems on all forests. It has several disadvantages--in most regions it will require special funds and there is the danger that personnel on the forests will lose interest in the work. In a region where timber management is the most important activity, such as the Pacific Northwest, placing the condition and trend job on a project basis seems best. On the other hand, in a region where range management is of paramount importance as in the Southwest the local forest basis seems most suitable. Even if conducted on a local forest basis it will at least require the full time services of one man within the regional office. His duties would be mainly training, inspection of field work, and to secure uniformity in methodology between forests. Once the work is underway his main job would be to see to it that interpretation of results was on a sound basis.

Whichever alternative is decided upon it should be the responsibility of the regional office to:

1. Provide leadership, in accomplishment of the condition and trend job.
2. Provide adequate training of personnel.
3. Furnish, with the direct cooperation of Range Research, the condition and trend standards and other technical assistance required in effective accomplishment of the work.
4. Correlate and secure uniformity in work standards throughout the region.
5. Furnish mapping control, base maps, aerial photographs, and whatever drafting is necessary in the case of special projects.
6. Participate in the analysis and interpretation of data particularly on critical or controversial range allotments.

Forest Supervisor

Since the development of range management plans, correlated to meet local needs is primarily a forest activity, it should be the responsibility of the Forest Supervisor to:

1. Collaborate with the Regional Division of Range Management on all phases of the condition and trend work including; ready adoption of condition standards and methodology, and the training of personnel.
2. Determine with his staff and the District Ranger involved, the order of priority of areas on which condition and trend work will be undertaken.
3. Make periodic inspections of the work, review maps and other data for adequacy and completeness and take such action as his findings justify to correct practices not in accord with instructions regarding methodology. Furnish the necessary instructions, forms, equipment, and supplies.
4. Where the work is undertaken on a local forest basis, provide the best technically trained staffman with direct responsibility for supervision and accomplishment of the work on the ranger district. His job would be to check for accuracy, adherence to standards, and methodology in order to secure a high level of excellence and to assure uniformity of the work on a forest-wide basis.
5. Where the work is projected out of the regional office, instruct his District Ranger to assist in the field work and final summarization and interpretation of data. This job will be provided for in each ranger's plan of work.
6. To review and check in the field if deemed necessary the interpretation of records obtained.

District Ranger

Inasmuch as the District Ranger is the land manager responsible for any action taken, and it is he who must put to use the information gained from the records, it is essential that he take an active part in the field work and fully understands the results. It is essential, too, that the ranger enlist the interest and assistance of the permittees. This would be the case even if the work were on a project basis and would include the mapping, initial installation, record taking and analysis on transect clusters and interpretation of results. The ranger as well as the stockman permittees also can be of invaluable assistance in the segregation of usable range from unusable areas. It is believed that the average ranger can make any subsequent records required in the follow-up field examinations, excepting the most intensively sampled allotments.

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SUPERVISION
Administrative Studies
(Condition and Trend)

Instructions for

MEASUREMENT AND OBSERVATION OF VIGOR, COMPOSITION AND BROWSE

By

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(Supplement to "A Method for Measuring Trend in Range Condition on National Forest Ranges" issued October 17, 1951)

Approved October 13, 1953

Chief, Division of Range Management

Chief, Division of Range Research

FOREST SERVICE

U. S. DEPARTMENT OF AGRICULTURE

INSTRUCTIONS FOR MEASUREMENT AND OBSERVATION OF VIGOR, COMPOSITION, AND BROWSE

INTRODUCTION

Since the issuance of the processed release "A Method for Measuring Trend in Range Condition on National Forest Ranges" October 17, 1951, various modifications have been made within the six western Regions of the Forest Service to improve the efficiency and usability of the 3-Step Method. Important and worthwhile modifications relate to observation or measurement of perennial grass vigor, the floristic composition of vegetation, and classification of browse. In the case of vigor , and especially with composition, the suggested procedures have resulted in a saving of field time in compilation and at the same time increased the sensitivity of the method. The procedure suggested for browse recognizes the need for additional information on areas where wildlife is involved. These modifications, it is believed, have been given sufficient trial to warrant consideration on all western National Forests where factual and permanent records on range condition and trend are needed and maintained. This information was previously made available for in-Service use by memorandum dated March 31, 1953. This material is processed herewith because of wide outside interest in the 3-Step Method and demand for information on it by other public land administering agencies, State experiment stations, and range management schools.

VIGOR

The current status of vigor of the most desirable group of forage grasses is important in condition classification. Changes in vigor from one period of time to the next is also an important criterion to follow in trend. Principal objections which have been raised in one or two regions to its use for either condition or trend are: (1) Vigor is obscured by the effects of current weather, (2) Vigor is difficult to describe or measure, (3) Widely-spaced climax perennial grasses may in some instances become more robust on range in poor condition than in the better condition situations. The first two objections are believed to have been met by the methodology specified in the 3-Step Method. The third criticism is not serious, since it is the very thing that we wish to see happen on ranges in unsatisfactory condition. Whenever a change is made in the intensity of grazing use, it is first reflected in vigor, later to be followed by changes in density, composition, and soil stability. Vigor is thus indicative of short time trends.

Present instructions (see Pars. 3 and 4, page 12, and example page 11b) relating to the determination of current vigor of perennial grasses are as follows:

> ... in the interpretation of the data on vigor, a new set of guides are computed for each subsequent year of examination in order to eliminate differences which might otherwise arise from the variable effects of weather on plant growth between different years. .... Also if the work is carried on season long, separate guides or at

(Over)

least a field check on the initial guides will be necessary for the middle andlate parts of the season in order to adjust them to current plant growth.

Guides on vigor for purposes of this classification are quickly and easily set up for a specific range type by measuring a minimum of 50 plants of each selected species on a range which has been subject to light grazing use for the past decade. If such areas are not available large fenced exclosures or areas with a long-time history of moderate use may be selected as alternates. Selection of the 50 plants for measurement should be made by random pacing as previously described for plants measured on the plots circumscribing the transects. Measurements are recorded to the nearest half inch and these data are then arranged from the longest to the shortest leaf length measurements and divided into five equal subgroups so that each subgroup makes up a proportionate part. The range in values for each of these subgroups is used as the basis for the criteria set up in the vegetation score card and for later rating of the data collected at each transect cluster.

An alternate method of setting up standards for classifying vigor has been devised and placed in use for several years by the Northern Rocky Mountain Station. It would replace only the portion of the instructions underlined above. It requires only the computation of the average maximum leaf or flowering stem length of the 50 or more randomly selected plants which are considered to be in optimum vigor. With this as a base the following scale is used to compare measurements (expressed also as the average of longest leaves or stems) taken at transect cluster sites:

Excellent (9-10 points)	= 95% or more	of	average	maximum	length
Good (7-8 points)	= 94 to 85%	"	"	"	"
Fair (5-6 points)	= 84 to 75%	"	"	"	"
Poor (3-4 points)	= 74 to 65%	"	"	"	"
Very Poor (0-2 points)	= 64% or less	"	"	"	"

As an example: If the average maximum leaf length of Idaho fescue is determined to be an optimum of 6.0 inches and the average maximum leaf length at the transect cluster site is 5.2 inches, then the vigor would be classified as good or 86% of the base.

In the more deteriorated condition classes measurement of vigor cannot be made because the most desirable class of perennial forage grasses may be entirely lacking. In such situations classification of vigor has to be ignored but because this does happen it should not preclude its observation in condition situations where measurement is possible.

Criteria for the evaluation of vigor other than leaf length such as number of seed stalks or size of dead centers on bunchgrasses have been developed in a few regions for several key indicator species. These standards should not be overlooked as a guide for rating vigor although their use entails a large amount of judgment on the part of the field examiner.

COMPOSITION

In condition situations where the perennial vegetation is sparse, for example, a plant density index of 20 or less, the loop or ring method of measurement does not give a good expression of the floristic composition. This is likewise true in the aspen weed type - which typically in good condition has lushly growing herbs which form a complete crown cover of the soil surface but actually is often made up of plants fairly well spaced. A better picture of the composition may be obtained by establishing more transects in a cluster or by doubling the usual 100 readings per transect line but this is tedious and usually prohibitive in time required to do the job.

A simple and effective means of getting a better picture of the composition is a method developed by the Pacific Northwest Station and in use by the Region. Its use also eliminates what may be a large amount of arithmetic in computing composition for individual plant species by the loop or ring readings. The method is described as follows:

1. Loop readings are recorded as described in the instructions and are used to give a picture of site sampled by transect with respect to bare soil, erosion pavement, rock, litter, club moss, plant density index, forage density index and ground cover index. This is an essential record for comparison with subsequent records taken in the future to determine any changes which may have taken place. No effort is made to segregate the readings with respect to individual plant species other than arriving at the forage density index.

2. Whenever a plant is encountered within the loop, it is recorded in accordance with usual procedure but in addition a dot tally by species is made of it. If no plant is found within the loop the procedure is as follows: The first perennial encountered and nearest to the loop either back toward the 0 end of tape 1 foot (in case of 100' transect) or at a backward angle, or straight out from the tape is identified as to species and recorded. Observations are properly recorded as a dot count under the subheads: most desirable, intermediate, and least desirable. The dot tally for each of these three groups of plants always totals 100. Composition so obtained and expressed is purely one of frequency but for purposes of showing trend the method appears to be sound.

A record of key indicator species not recorded by the above method, but within the 100' x 150' plot circumscribing the transect is also maintained in accordance with the instructions.

BROWSE

At the conclusion of the range condition and trend conference held at Manitou in August, 1951, it was agreed to adopt the 3-Step Method for western wide use in grasslands, including meadows, open timber and sagebrush-grass types. Since then, research and experience warrants the extension of the method to other browse types characterized by such species as mountain mahogany, bitterbrush, snowberry, and ceanothus. Tall, scraggly browse species such as chokecherry and willow still remain a problem in measurement. Greatest interest and effort expended in the development and use of a method to obtain a factual record on browse has been in Region 4 in connection with their wildlife studies. Formalized instructions are now in process of preparation. However, the basis for these rests heavily on the methodology developed and now placed in wide use by the California Department of Fish and Game who are conducting many studies in cooperation with Region 5. The method as described by Wm. P. Dasmann in "Deer Range Survey Methods" 24 pp., mimeographed, dated December 1, 1952, is quoted freely herein as it relates to age and form classes of shrubs.

The usefulness of the information obtained on shrubs and its future analysis and interpretation is something which should be carefully and jointly considered by administration and research. This is particularly true as it relates to objectives in management of ranges where livestock and game use may be in conflict. It is also true as it relates to the shrub species involved.

Measurement of Browse

Present instructions as to the procedure to be followed in recording data in shrub types remain unchanged. However, the following suggestions are added for additional clarity with respect to equipment, field procedure and summarization of data:

1. Equipment. In order to assure tape replacement on re-measurement of transect lines the tape should, if possible, be held above the crowns of the shrubs. This necessitates the use of tape holders such as described by L.R. Short "New Equipment for the 3-Step Method", Research Note 111, Northern Rocky Mountain Station issued August 1952; or similar equipment described by G.D. Pickford and George Stewart in "Coordinate Method of Mapping Low Shrubs" Ecology 16 No. 2, pp. 251-261, April 1935. Although special tape holding equipment is desirable, lack of such equipment should not discourage undertaking the job. This may be effectively accomplished by means of two stakes made up of 3/8 to 5/8 inch tool steel rod - 3 to 4 feet or more in length, sharpened at one end to permit ease of driving into the soil. A third and similar-sized stake may be found helpful in support of the tape at the center of transect and for keeping the tape directly centered over the transect line stakes. The tape is stretched by means of a steel spring attached to one end of the tape

and drawn into place by a turnbuckle attached to the other end (described in Region 3 Handbook). Both spring and turnbuckle are inexpensive and available at any hardware store.

Whenever the tape is held a foot or more off the ground surface, a plumb bob - with attached string 5 feet or more in length should be used in lieu of the 3/4 diameter loop or ring.

2. Field procedure. Readings are taken by the plumb bob (a triangular lead fishing weight will serve) as in the case of the 3/4 diameter ring, except that the point of the plumb bob has to be visualized as encompassing an area similar to that of the loop. Other than this the method is basically similar to the line point method described by Dasmann. A "hit" is recorded when the point falls within the circumference of the live perennial crown (current annual twig growth on the periphery is ignored) even though the 3/4" point is directly over or under an interspace. Portions of the crown which are dead with no live crown above or below the loop are also recorded and are indicated by encircling the plant symbol. They are not, however, considered in the plant density summary and are mainly of value for future comparison as to death loss.

3. Summarization. As pointed out in the instructions, shrubs are recorded up to 5 feet in height and constitute the item of "over-story," and is always included in the "plant density index" and may or may not be included in the "forage density index". Surface vegetation directly beneath the shrubs is summarized as "understory" and is not considered in the computation of either the plant density or forage density index; except in cases where the crown of the shrub is recorded as being dead, or in cases where the "browse line" is so high that animals may readily graze beneath the crown as often occurs with juniper.

Shrub Counts

Where vegetation is sparse, the line transect may not give an adequate picture of the shrub population, particularly on well established seedlings. In such situations additional information may be desirable. A suggested means of providing this is to note the number of shrubs by species and by age and form class as they occur in a strip plot wherein the transect forms the center line. Shrubs must be rooted within this strip to be counted. A plot 1 foot wide and 87.1 long is 2/1000 of an acre in size and should serve for most situations. Several larger plot sizes of 1/100 acre or multiple thereof are shown on the attached transect form developed in Region 4.

Age Classes of Shrubs

As pointed out by Dasmann:

> The relative abundance of various plant species on a range may be an expression of site, competition, or fire. Or it may result from pressure by range animals. The absence of one or more age classes from a stand should give cause for deliberation, especially when younger age classes are scarce or absent even though older classes are dying out. The effect of climatic cycles, and of soil changes due to erosion, leaching, or fire, may favor some plant species at the expense of others, with a consequent falling off in reproduction of the suppressed species. Stands of vegetation of full density (i.e., optimum stands for the particular site involved) may lack a representation of younger age classes because of severe competition from established vegetation. Species of plants that re-seed satisfactorily only after burning make up another group from which young age classes may be absent due to a cause other than grazing or browsing pressure. But where ranges are overstocked with range animals, the younger age groups of preferred forage species are particularly susceptible to losses resulting from over-cropping.

On the other hand where ranges are understocked or properly stocked, we may expect the younger age classes of the desirable browse species to make their appearance and generally the younger age classes of the undesirable species will be sparse or lacking.

Age classes are designated (see figures 1,2,3) as follows:

Established Seedlings: Very young plants, which have become firmly established and yet are obviously new arrivals on the range. These are usually distinguished by their relative size, simple branching and succulent bark. Tree browses, such as juniper, with predominantly juvenile foliage and up to three feet in height are placed in this category.

Young plants: Larger, and with more complex branching and more fibrous bark, than seedlings, but do not as yet show size and signs of maturity such as rounding crowns. Juniper poles up to 10 feet are placed in this category.

Mature plants: Complex branching, rounded growth form, larger size, heavier and often gnarled stems. Crown is made up of more than three-quarters living wood.

Decadent plants: Shrubs and trees which are dying from age or other factors. Crowns show more than one-quarter dead wood.

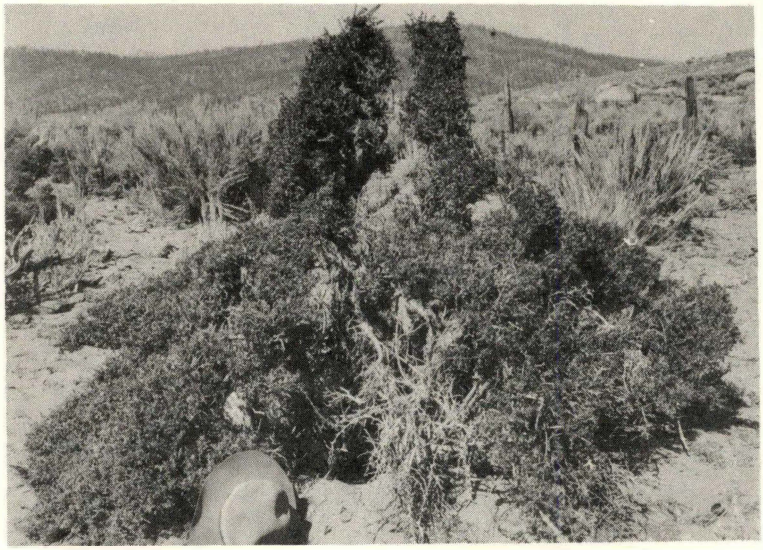

Figure 1. Bitterbrush (Purshia tridentata). Age Class: Mature. Form Class 3: all available, tightly hedged; Designation: "Putr M3".

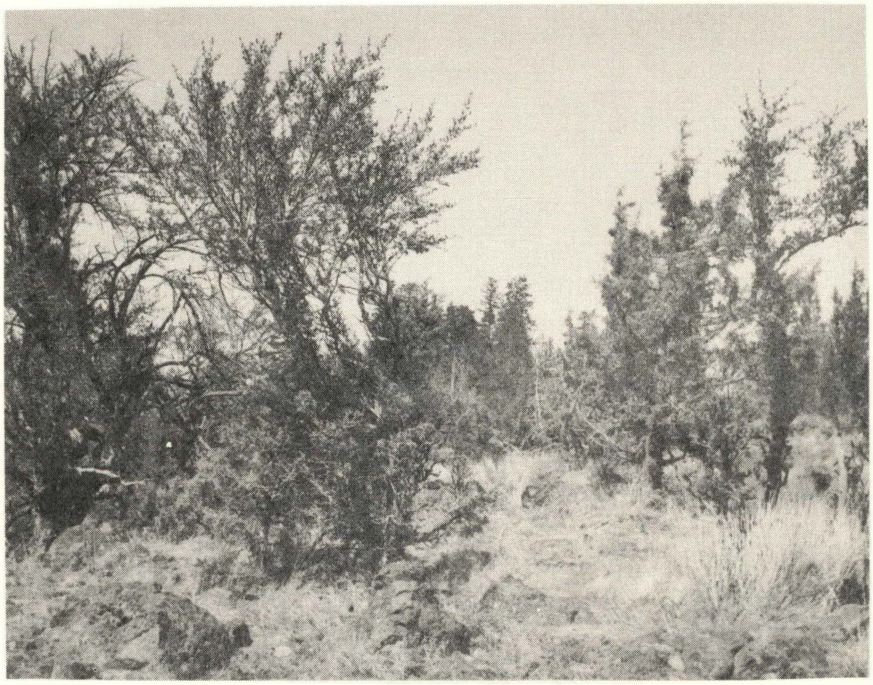

Figure 2. Bitterbrush. Age Class: Mature. Form Class 6: largely available, closely hedged; Designation: "Putr M6".

Figure 3. Juniper. Age Class: Mature. Form Class 8: Unavailable. Designation: "JUN. M8".

Form Classes of Shrubs

Form classes are a composite rating of degree of hedging and of present availability of forage. Hedging is a product of past grazing use and should not be confused with current cropping. Availability may result from height, location, or density of plants.

Data on form classes by species are recorded as shown on the attached transect record.

Data on form classes of the various browse species can be used to determine "browsing pressure in the recent past, relative importance of different browses and amount of forage currently available. When correlated with age classes, the data will indicate trends in carrying capacity as influenced by both availability and productive vigor of browse plants."

Forms of browse plants are as follows:

Form class 1: All available, little or no hedging.
Form class 2: All available, moderately hedged.
Form class 3: All available, tightly hedged.
Form class 4: Largely available, little or no hedging.
Form class 5: Largely available, moderately hedged.
Form class 6: Largely available, tightly hedged.
Form class 7: Mostly unavailable.
Form class 8: Unavailable.

Pellet Group Counts

Region 4 has found pellet group counts to be the most reliable present means of (a) separating degree of current game use from cattle grazing use, (b) arriving at an estimate of actual use vs. proper grazing use. The method involves a simple count of pellet groups or droppings within a plot 1/100 acre in size or multiple thereof, circumscribing the permanent transect line - as shown on the attached form. Converting factors for estimating actual current grazing use of deer, elk and cattle are also shown. The method is of sufficient promise to warrant trial elsewhere.

RECORD OF PERMANENT LINE TRANSECT

G (W)
MANAGEMENT
Condition and Trend.

Cluster Name and Transect No.

Forest | Ranger District | Allotment | Date | By

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

KEY INDICATOR SPECIES NOT RECORDED (Include undesirable invaders and annuals)

VIGOR MEASUREMENTS

Species
1
2
3
4
5
6
7
8
9
10
Total
Av. Max.

Tape Height at Stakes:

	SYMBOL	SPECIES (List by symbol, name and number of hits)
BARE SOIL	—	
EROSION PAVEMENT	P	
ROCK	R	
LITTER	L	
MOSS	M	
PLANT DENSITY INDEX		
Total	100	
FORAGE DENSITY INDEX		
DESIRABLE PLANT INDEX		
GROUND COVER INDEX		
Overstory		
Understory		

PELLET GROUP COUNT
Plot Size
Deer
Elk
Other

ANNUALS (List by Species)

Indicators	Others

OVER

General Instructions

List overstory species at the top of each block and circle symbol when it is a dead portion of a living shrub.

Age Classes of Browse Plants 1/	Form Classes of Browse Plants 1/	
	Class	
	1	All available, little or no hedging
S - seedling	2	" " moderately hedged
Y - young plant	3	" " closely hedged
M - mature	4	Largely available, little or no hedging
D - decadent	5	" " moderately hedged
	6	" " closely hedged
	7	Mostly unavailable
	8	Unavailable

On game ranges classify all browse hits up to 5 feet as M3, D6, S1, Y2, etc. Tally in block directly behind browse species as "ArtrM2", etc.

Pellet Group Counts

Plot size should be 1/100 acre, or a multiple of same, using the tape as the plot center line. Alternative dimensions that may be used are:

Width:	6.6 feet or ~~78.1~~ 79.2 inches (3.3 ft. each side of tape)	or	6 feet or 72 inches (3 ft. each side of tape)
	and		and
Length:	0 to 66 ft. gives 1/100 acre 0 to 99 ft. gives 1.5/100 acre		0 to 72.6 ft. gives 1/100 acre 0 to 108.9 ft. gives 1.5/100 acre

Example: A cluster with two transects and plots 6.6 feet wide and 0-99 feet in length samples 3/100 acre.

Converting factors:

13 pellet groups per day for deer
13 " " " " " elk (tentative estimate)
12 droppings per day for cattle

Notes

1/ Dasmann, Wm. P. Some deer range survey methods. Calif. Fish and Game, Vol. 37, No. 1, Jan. 1951.